THE

FRANKLIN JOURNAL,

AND

AMERICAN MECHANICS' MAGAZINE;

DEVOTED TO THE USEFUL ARTS, INTERNAL IMPROVEMENTS, AND GENERAL SCIENCE.

DECEMBER, 1826.

Report of the Committee of the Franklin Institute, on the Inclined Plane of Professor James Renwick.

[CONTINUED FROM PAGE 263.]

EXTRACT FROM THE REPORT OF GENERAL S. BERNARD, AND LIEUTENANT COLONEL JOSEPH G. TOTTEN, *(of the United States Engineer department)* ON THE MORRIS CANAL.

"The great expense of such a system of locks, in first cost, in water, and in time, would have been fatal to the project; but happily, the science and ingenuity of Mr. Renwick, aided by the success of analogous attempts in Europe, have found out an expedient by which this formidable elevation of the summit, may be overcome at a comparatively small expense. His idea is, the combination of locks and inclined planes, or rather the use of either, as local circumstances may dictate; the plan of Mr. Renwick, bold, ingenious, and novel, promises such improvement in the mode of passing from one level to another, and indeed such a facility in overcoming obstacles, which, in the existing mode, might be regarded as insuperable, that we consider it our duty, to enter with some minuteness, into its details.***

"As to the time which will be taken to pass the locks, we will assume the maximum given by experience, viz:—1st case. A descending boat, finding the lock full, 6 minutes; viz: 1½ to enter, 3 to fill, and 1½ to leave the lock.—2nd case. A descending boat, finding the lock empty, 9 minutes; viz: 3 to fill, 1½ to enter, 3 to empty, and 1½ to leave the lock.—3d case. An ascending boat, finding the lock empty, 6 minutes; viz: 1½ to enter, 3 to fill, and 1½ to leave the lock. 4th case. An ascending boat, finding the lock full, 9 minutes; viz: 3 to empty, 1½ to enter, 3 to fill, and 1½ to leave the lock. The mean of these four cases is 7½ minutes.

"We pass on now to an examination of the proposed canal, in the most favourable point of view, that is, as it appears under favour of the ingenious invention of Mr. Renwick.

"Fixed locks were, for a long time, the only means in use for getting over the elevations in the route of canals; but although they are certain, and safe, where there is a sufficiency of water, experience and reflection both show, that they are inapplicable where the quantity of water is small, and inadmissible where the elevations are so considerable as to extend the cost of construction, and the time of making the passage, beyond certain limits. Even in cases where they are advantageously applied, there is this inherent objection, that they require more water to pass a boat, than is sufficient to float the boat. * * *

"Several engineers of reputation have occupied themselves with researches, as to proper substitutes for locks, in cases where these only, can be applied advantageously. Messrs. Fulton, Leach, Reynolds, Ducart, Anderson, Rowland, Pickering, Weldon, and the Duke of Bridgewater, in England, and Solages, Bossut and Forey, in France, have severally proposed plans of this nature; and some of them have been carried into successful operation. Reynolds constructed, at Ketley, in Shropshire, an inclined plane, with two parallel iron railways: a loaded descending boat, by means of a rope passing round a wheel at the upper end of the plane, drew up a half loaded boat. On the Duke of Bridgewater's canal, is an inclined plane analogous to the above, in full operation.

"On the Ellismere canal, in Derbyshire, Rowland and Pickering, constructed a moveable lock, with a vertical lift and counterpoise. Mr. Weldon employed nearly similar means in the coal canal near Bath; and, lastly, a moveable lock, on similar principles with the last, was successfully applied by Forey, on the plans of Bossut and Solages, to the "Canal du Creusot," in France. The expedients proposed by these engineers, are of two kinds: *first*, inclined planes, with parallel rail-ways, on which the boats ascend and descend alternately, and *secondly*, vertical lifts, working in a similar manner. Either of these expedients is applied, and sometimes both, as local circumstances require.

"The invention of Mr. Renwick is of the first kind. It is an inclined plane, on which are fixed two parallel sets of iron rail-ways, (see plan, profiles, &c. herewith,) each set serving for a lock to ascend and descend. The lock is supported upon, and moves with, a carriage, the top of which is horizontal, the bottom being parallel with the inclined plane. Under the bottom of the carriage, and securely fastened to it, are a number of iron truck wheels in two rows, corresponding with, and revolving along, the rail-way belonging to the lock; two strong chains are secured to, and passed round a drum at the end of the upper level; the other parts being brought down and fastened, one on each side, to the lower part of the lock. As each of these chains is strong enough to sustain a loaded lock, all danger of accident, during the transit, is guarded against. The two locks used by Mr. Renwick, on his inclined plane, are precisely alike, in all

respects; but as there are two cases likely to occur in the application of this invention, requiring different methods of giving motion to the locks, it is necessary to describe the method devised for each.

"1st. The case, when the triangular space between the end of the lower level, and the lower part of the inclined plane, can be kept dry, by draining. On this supposition, it will only be necessary to have a drum at the end of the upper level, extending across both rail-ways; to wind the chains of one lock around this drum, in a different direction from the chains of the other lock, and to have the chains of one lock wound up entirely, and the lock at the top of the plane, while the chains of the other are unwound, and the lock at the bottom. Such being the arrangement, it is obvious, that by permitting the escape of a little water from the lower lock, the upper will preponderate, and by descending and turning the drum, wind up the chains of, and, of course, draw up, the lower lock. This will, however, be an accelerating motion, unless water is permitted to escape gradually from the descending lock; because the lengthening chain in the one lock, and the shortening chain in the other, continually increase the preponderance of the descending lock.

"2nd. The case, when, from there being no lower ground near, the triangular space must be kept full of water. Here, the above simple arrangement will not answer, because the moment the descending lock enters the water of the triangular well, it loses its relative weight, and soon ceases to preponderate. To surmount this difficulty, Mr. Renwick has introduced the following very ingenious device. Instead of a drum common to both locks, there is one for each lock, and each drum is provided with two spur-wheels, of different diameters: the two small wheels of the two drums are, however, alike as to the diameter and number of teeth, as are the two larger wheels. The intention of this contrivance, is, that by gearing the large wheel on the drum of the lock about to descend, with the small wheel on the other, the descent of one lock to the edge of the water, will draw up the other the whole length of the plane; because a given number of revolutions of the larger will produce a greater number of revolutions in the smaller wheel, and of course, in the drum on which the chains are wound; but the descending lock, after effecting a complete transit of the ascending lock, has still a short descent to make before arriving at the end of the lower level. This is done by ungearing the drums entirely, and letting the lock descend by its own weight, taking care, however, to check this motion properly, in a way not unlike that of checking the chain cables of ships.*

"The passage of boats, from one level to another, is a very simple operation, in either of the cases stated above. A boat, arriving at either end of the inclined plane, passes at once into the moveable lock, which, being fastened to the end of the canal level, is, as it were, a prolongation of that level; the gates are then shut, and the transit takes place, whether there be a boat in the other lock or not.

* Another method of obviating this difficulty resulting from the water contained in the lower level, is described by Betancourt; this plan is described in the present number of this Journal.

"Before comparing the expense of these moveable locks, with that of fixed locks, we will observe, that the correctness of the principles on which this invention depends, and the success of like contrivances in Europe, leave no reason to doubt of its perfect fitness to the object in view, and of its great utility.

"A just comparison of these, with ordinary locks, requires an examination of the cost of construction, the loss of water, and the consumption of time.

"From Mr. Renwick's estimate, it appears that a foot of the inclined plane, with its iron rail-ways, and the chains for the locks, costs $133 63.

The moveable locks, - - - - - - - -	824 00
The masonry, wood work, and machinery at the top and bottom of the inclined planes, - - - - - -	2312 00
	$3136 00

"The first sum above stated, must, in each case, be multiplied into the number of feet lift required for the inclined plane; the second, being a constant quantity, is to be added to that product, for the whole expense. As one of these is a constant, and the other a variable quantity, the price per foot lift will be variable, diminishing continually with the increase of the number of feet in the lift: and, as the constant quantity is considerable, it will be found, that at short lifts, the advantage as to expense, will be in favour of fixed locks; but the inclined plane is inapplicable when the length does not exceed a certain quantity; and it will be found, by consulting the following table, that there will be considerable economy in its use, from the moment the fall is great enough to admit its application. It will also be seen, on reference to the table, that the price of fixed locks per foot rise (with a given lift to each lock) is constant, and that for 48 feet of rise, the whole expense is about twice, and for 120 feet, about twice and a half, as much as that of moveable locks. The table is calculated on the supposition that the inclined plane makes an angle of 14 deg. 28 min. 40 sec. with the horizon, or in other words, that the vertical rise being one, the length of the inclined plane is four.

TABLE

Showing the comparative expense (in dollars) of moveable and fixed locks, from 8 to 152 feet rise.

	Vertical heights of inclined plane.	Length of the inclined plane.	Price per foot lift of inclined plane with moveable locks.	Total price of the whole lift with moveable locks.	Price per foot lift of common locks.	Total price of the whole lift with common locks.	Difference in that cost between fixed and moveable locks.
1	8	80	$525 50	$4,205 04	$400	$3,200	$1,005 04
2	10	96	447 23	4,472 30		4,000	472 30
3	12	112	394 96	4,739 56		4,800	60 44
4	16	128	329 63	5,274 08		6,400	1,125 92
5	20	144	290 43	5,808 60		8,000	2,191 40
6	24	160	264 30	6,443 12		9,600	3,256 88
7	28	176	245 63	6,877 64		11,200	4,322 36
8	32	192	231 63	7,412 16		12,800	5,387 84
9	36	208	220 74	7,946 68		14,400	6,453 32
10	40	224	212 03	8,481 20		16,600	7,518 80
11	44	240	204 90	9,015 72		17,600	8,584 28
12	48	256	198 96	9,550 24		19,200	9,649 76
13	52	272	193 93	10,084 76		20,800	10,715 24
14	56	288	189 63	10,619 28		22,400	11,780 72
15	60	304	185 89	11,153 80		24,000	12,846 20
16	64	320	182 63	11,688 32		25,600	13,911 68
17	68	336	179 75	12,222 85		27,200	14,977 16
18	72	352	177 04	12,757 36		28,800	16,042 64
19	76	368	174 89	13,291 88		30,400	17,108 12
20	80	384	172 83	13,826 40		32,000	18,173 60
21	84	400	170 96	14,360 92		33,600	19,239 08
22	88	416	169 25	14,895 44		35,200	20,304 56
23	92	432	167 71	15,429 96		36,800	21,370 04
24	96	448	166 29	15,964 48		38,400	22,435 52
25	100	464	164 99	16,499 00		40,000	23,501 00
26	104	480	163 78	17,033 52		41,600	24,566 48
27	108	496	162 66	17,568 04		43,200	25,631 96
28	112	512	161 63	18,102 56		44,800	26,697 44
29	116	528	160 66	18,637 08		46,400	27,762 92
30	120	544	159 76	19,171 60		48,000	28,828 40
31	124	560	158 92	19,706 12		49,600	29,993 88
32	128	576	158 12	20,200 64		51,200	30,959 36
33	132	592	157 40	20,775 16		52,800	31,024 84
34	136	608	156 68	21,309 68		54,400	32,090 32
35	140	624	156 03	21,844 20		56,000	34,155 80
36	144	640	155 40	22,378 72		57,600	35,221 28
37	148	656	154 82	22,913 24		59,200	36,286 76
38	152	672	154 26	23,447 76		60,800	37,352 24

It will be observed that the first quantities in the last column of the table, are in favour of the common fixed lock, all the others being in favour of the inclined plane. Only $400 is assumed as the cost of locks per foot rise, on the Morris Canal; the usual price is about $800 on the majority of canals of small section in the United States.—[*Note of the Committee.*

"What has been said, is sufficient to show the great advantage as to economy, which these moveable locks have over the common fixed locks; but, in relation to comparative expense, it only remains to add, that this advantage will increase with the sines of the angles of elevation of the inclined planes, up to that degree of elevation which experience will show it will be hazardous to exceed.

"The quantity of water used by these moveable locks, is the least possible, since they contain no more than is sufficient to float the boat, which, as has been said, is far from being the case with fixed locks. It is true, that if a moveable lock, having descended without a boat, receives a boat at the lower level, to carry up, it will lose part of the water brought down: but this is compensated when the case is the reverse; that is, when the lock, having brought down a boat, is to ascend without one; for then the lock receives water from the lower, to carry back to the upper level. The absolute loss for each transit, being always only that which is permitted to escape from the lock at the bottom, that the lock at the top, may preponderate sufficiently to overcome the friction of the truck wheels.

"As the moveable locks contain no more water than is necessary to float the boat, no time is lost, as is the case in fixed locks, in emptying and filling them. On the entrance of a boat, the water which is displaced, passes into the canal, and on its exit, water rushes into the lock, to fill the space it occupied, the trifling deficiency of water in the ascending boat, making no sensible difference. The time employed by a boat, therefore, in making a transit from one level to another, is consumed, first, in entering a lock, second, in moving along the inclined plane, and third, in passing out of a lock. Supposing the lifts to be sixty-four feet, and the inclination of the plane 14 deg. 28 min. 40 sec. the length to be moved over by the boat, will be 250 feet. This might be passed very rapidly; but with a view to save the machinery, and to guard against accidents, and also to allow for the time required to adjust the locks to the end of the canal, and to regulate the preponderance of the upper boat, we take twenty feet, per minute, as the velocity of the locks. In these suppositions, the time consumed will be as follows:

	min.
To enter the lock	1½
To move over the inclined plane	12½
To leave the lock	1½
Total, 15½ minutes to rise 64 feet,	15½

"To the same height of 64 feet, with 8 common locks, at 7½ minutes each, the time would be 60 minutes, or four times that required by moveable locks.

"We might show, in addition to the above striking general advantages, the great superiority of the moveable lock, in case of a great and sudden descent, where common locks must necessarily be contiguous, or near to each other; but we consider all further comparisons, of this sort, superfluous.

"It has been before stated, that the whole ascent and descent of the Morris canal is 1644 feet, and that to pass the 206 fixed locks,

which that number of feet requires, would take 25 hours and 46 minutes, which added to the 19 hours required to pass along the levels, gives a total of 44 hours and 45 minutes, or at 12 hours a day, $3\frac{2}{3}$ days. But by combining the system of fixed locks, with inclined planes, as Mr. Renwick proposes, the whole passage will be made in 28 hours and $33\frac{1}{2}$ minutes, or in $2\frac{1}{3}$ days, as will be seen below. Along the route of the canal, there are several small depressions of level, in which fixed locks alone can be used: and the whole amount of these is 244 feet, leaving 1400 feet for the inclined planes. Giving 8 feet lift to the locks, and 64 feet to the planes, the time occupied in the passage will be as follows:

	h.	*min.*
For 244 feet lift with locks, requiring 31 locks at $7\frac{1}{2}$ minutes each,	3	$52\frac{1}{2}$
For 1400 feet lift, with planes requiring 22 planes, at $15\frac{1}{2}$ minutes each,	5	41
For passing along the levels, as before stated,	19	00
Total time in hours and minutes,	28	$33\frac{1}{2}$

The gain will, therefore, be $1\frac{1}{3}$ days in each passage.

"We will now see what this will amount to, as regards economy of transportation, both with respect to the boats, and to the men employed with them.

"Supposing 291,000 tons are to be transported from the Delaware to the Passaic, in eight months, or 240 days, there will be 1212,5 tons per day, which, at 25 tons a boat, will require 48 boats to leave the Delaware, daily. With a system of locks, $3\frac{2}{3}$ days will be consumed in reaching the Passaic; 1 day in unloading, $3\frac{2}{3}$ days in returning, and 1 day in taking in a new cargo, making $9\frac{1}{3}$ days. It will be necessary, therefore, if 48 boats are to leave the Delaware every day, to employ nine times 48 boats, or, in the whole, 432 boats. But, with the system of inclined planes, combined with locks, $2\frac{1}{3}$ days will be consumed in the passage; 1 day in unloading, $2\frac{1}{3}$ days in returning, and 1 day in taking in a new cargo, making only $6\frac{2}{3}$ days: on the 7th day, the boats might begin the second voyage; but we will suppose that they do not until the eighth, which will require seven times 48 boats, or, in the whole, 336 boats. Now, as 336 is about the $\frac{4}{5}$ of 432, it follows, that there will result a saving of about 20 per cent. on the charter of the boats. A like economy will result in regard to the men employed with the boat; for in one case, 864 men must be employed during 8 months, and in the other, only 672, to transport the 291,000 tons, giving a saving of about 20 per cent. in the number of the men. The consequence will be the same also, as regards animal labour; and it is scarcely necessary to remark, that all these savings must diminish the price of freight in the same proportion.

"We here terminate our report on the projected Morris canal; having gone into the extended and minute examination which we thought due to a project so important in its general and local relations. This examination, shows that the project, under any point of view, is practicable as to cost, and promising as to revenue; but that, in both these respects, there is a decided preference to be given to a system of in-

clined planes, combined with fixed locks, as proposed by Mr. Renwick. It is to be greatly desired therefore, that the invention of this gentleman, may be sanctioned by experience; because, not only will the execution of the design, as it slowly progresses, enable him to mature and perfect its details, but it is experience, alone, which can effectually remove the fears and doubts with which inventions, the most useful, are, at first regarded. To us, however, whether we consider the economy, the utility, or the durability of these inclined planes, ALL IS CERTAIN; and we look confidently forward to the day when their introduction will be regarded as a most important era in the history of canal navigation, and especially in this country, to which they are so peculiarly adapted."

Signed by S. BERNARD, Brig. Gen.
JOSEPH G. TOTTEN, Maj. Eng.
Brev. Lieut. Col.

Your committee having now submitted these strong and conclusive testimonials in favour of the plan of Mr. Renwick, beg leave to offer their opinions, which entirely accord with those of the engineers, herewith submitted, in relation to the utility of the plan.—Your committee respectfully offer a few suggestions, respecting some improvements, which they are induced to believe may still further increase the utility of the project.

1st. To ensure a more equal bearing of the wheels of the lock carriages, on the rail-way of the inclined plane. If this plane were *mathematically accurate*, and the wheels *perfectly cylindrical*, and, if they were inserted into a beam *perfectly straight*—and, if all these arrangements could be rendered *permanent*—each wheel, of the 8 proposed in the plan, would, at *all times*, support an *equal* proportion of the superincumbent weight; but this is obviously impossible, and, in consequence thereof, certain parts of the apparatus will be liable to an *unequal* and *variable pressure*, sometimes of great intensity, and increasing in proportion to the wearing of the materials. The committee are of opinion, that this defect may be partially obviated by a contrivance similar to that which may be observed in the arrangement of the wheels of some of the locomotive steam engines in Great Britain;—viz. the wheels may be attached, in pairs, to a connecting beam, which will support the carriage by a pivot attached to its centre, on which it will traverse; one of these beams must be attached to each corner of the car, or moveable lock, and a wheel be inserted therein, at each extremity; the weight reposing on each corner of the car, will then be equally sustained by each pair of wheels. If a heavier lock carriage be required, for the purposes of navigation, these wheels may be indefinitely multiplied on this principle, without any necessity of resorting to a rail-way of increased strength.

2d. To ensure the contact of the upper moveable locks, by some other means than the mere preponderance of the descending cars. If this be not effected, a waste of water will occur. A powerful screw, or lever, may be attached to the termination of the upper levels, and worked by the attendant, which will accomplish this object.

3d. The section of the present locks, exhibits *rectangular* parallelo-

grams. As the section of a boat seldom exhibits, and never ought to exhibit, this figure, the sides of the lock ought not to be vertical, but should be adapted to the curvature of the sides of the boats employed. As less water will be contained in the locks, if this plan is adopted—less friction will be the result; consequently, less power will be expended, to overcome the resistance. The resistance may be still further reduced, by increasing the diameter of the wheels, sustaining the locks on the inclined plane.

4th. To prevent accidents, from the accelerated velocity of the locks on the inclined plane, which might result from the negligence of the superintendents of the apparatus, in neglecting to apply the stoppers to the chain cables.

If a centrifugal, or an hydraulic brake, were attached to the apparatus, all danger from the above cause, would be completely obviated, and the locks could safely proceed on the plane with greater velocity, than a proper regard for their safety would justify, on the present plan.

These alterations would, in the opinion of the committee, increase the utility of this valuable apparatus.

We now conclude this examination of the ingenious project, which has been submitted to our attention, by congratulating our fellow citizens on the appearance of a plan, by which the mountains and hills of our country, which, at present, prevent a free, uninterrupted, and economical exchange of the productions of agriculture, commerce, and manufactures, may soon cease to be *insurmountable* obstacles to this beneficial intercourse;—a plan, the importance of which, will become every day the more apparent, until the present system of canal navigation be superseded by other means, which the progress of science may hereafter establish. The committee, therefore, recommend, that a medal be presented to James Renwick, for his improvements effected in the apparatus for working the Inclined Plane.

Signed,

JOHN WILSON, Civ. Engr.
HARTMAN BACHE, Top. Engr.
GEORGE W. SMITH,
GERARD RALSTON,

Committee on the Inclined Plane, of Professor James Renwick.

Letter from Professor James Renwick to G. W. Smith, Esq. one of the Committee of the Franklin Institute, to which the examination of the model of the Inclined Plane, &c. was referred.

Columbia College, New York, October, 1826.

SIR—I reply with pleasure to your question: "How far the plan of an inclined plane, sent by me to the exhibition of the Franklin Institute, is original?" I do this with the more alacrity, as I do not conceive, that in the present state of science, reputation, as an engineer, is to be derived from a search after novelties, but, rather from an adaptation, successfully, to useful purposes, of known machinery, and

received philosophical principles. Were, indeed, my plan, in every respect, a copy, I should not hesitate to avow it, as I should feel it a sufficient honour to bring, to the notice of the public, a valuable, but forgotten invention. It is, indeed, no unimportant part of the duties of my Professorship, to keep alive, or restore, the inventions of earlier date. But, this is not the case with the inclined plane, whose model has been submitted. I have not, after the most diligent enquiry, hesitated to take the oath prescribed by the patent law, and I procured the signatures, as witnesses, to my specification, of the late and present heads of the United States Board of Engineers, after they had, also, examined the question of originality: a question, of which their greater opportunities for research, made them more competent judges, than myself.

The model exhibited, is the result of the investigations I undertook at the desire of the New Jersey Commissioners, who, in examining the route of the Morris Canal, became aware, at an early period, that it could not be executed, within any reasonable limit of cost, by the ordinary method, and would not, if so executed, be of any great value, either to the state, or its stockholders, in consequence of the great length of time that would be consumed in passing through from 160 to 200 locks. The exact course of my studies, on the subject, is detailed in my report to those commissioners, and, as that is in your hands, I need not here repeat what I have there stated.

The principle of two counterpoising locks, filled with water, and each carrying a boat, to which system, motion is given, by letting water from a lower lock, is first stated by Dr. Anderson, in his plan for a perpendicular lift; but, in spite of numerous attempts to bring it into use, it has never been applied successfully. I was not, at the time, aware, that to apply this principle to the inclined plane, had ever occurred to any person whatever. The project of Leach, referred to, in the report of the United States Engineers, on my inclined plane, although it comprises the principle of counterpoising weights, one of which might be wholly, or partly water, yet adopts an extrinsic force, as the prime mover. I do not remember, that I derived any advantage from the perusal of it, although I have subsequently found, that it was assumed by De Solages, in France, as the basis of an investigation, which departed from the same point whence I set out, but which led, as I shall hereafter explain, to a widely different result.

The necessity of suspending each car, or lock, by at least two chains, occurred to me in consequence of an accident that had nearly been attended with fatal consequences, at Rochester, in this state, upon an inclined rail-way. In seeking the best means of gearing two chains, I fell upon the horizontal shaft, and thence passed, for the sake of convenience, to two horizontal shafts, turning each other, in opposite directions, by means of spur-wheels.

At this stage of the investigation, an examination of one of the proposed sites, near Stanhope, in New Jersey, showed me, that cases would occur, where the descending lock must enter the water of the lower level; a variation in the size of the spur-wheels, suggested it-

self, at once, as a remedy, and, of course, the necessity of having one, of each size, upon each of the shafts, with a lever to throw them, alternately, in, and out, of gear. I soon afterwards discovered, that the same difficulty had occurred to Betancourt, who had contrived a mode of overcoming it. This mode is much more complex than mine, which grew, naturally, out of the position and action of the shafts.

In relation to the manner of supporting the locks constantly in a horizontal position, I was aware, that wheels of different diameters, had been actually used, (at Hadley;) but I saw many objections to their employment, so that, from the very first, the idea of a triangular frame, beneath the lock, supported upon wheels of equal diameters, occurred to me. In constructing the model, I derived the hint of the mode of fitting the wheels, (a matter of no great importance,) from a draught of Morton's marine rail-way, which I had before me, when consulted by the original projectors of the Dry Dock Association.

You may have remarked, that in the model, the joint between the locks and the gates of the canal, is rendered tight, by leather; this, I do not think, would answer well on the full scale; but, I have a mode of effecting that object, which, I am satisfied, will succeed fully; but which however, I do not wish to publish at present, any more than several other little matters that frequent reflection on the subject, and experiments on the model, have suggested; and which, if not essential, will, at least, contribute to the success of the operation.

The reservoir beneath the locks, is no part of the plan, at least as necessary to the full size. The model, originally, worked well without it, although containing but two-thirds of the water, in proportion to its size, that the large one would. But, the reservoir was added, in consequence of the risk of rust, and injury to the parts, that were anticipated, when the model was sent to Trenton, for exhibition to the Legislature of New Jersey.

After the United States Board of Engineers had nearly completed their report, General Bernard was informed by Count Real, that he had in his possession, at his house on the St. Lawrence, a plan, founded upon principles similar to mine. The plan was sent for, and anxiously expected. On examination, it appeared to be the work of De Solages, who, as already stated, acting upon the hint furnished by Leach's project, had set out from the same point with me, but had found insuperable difficulties, in adapting two moveable locks to his inclined plane, and had, finally, been compelled to limit himself to one lock, counterpoising it by two reservoirs, moving upon two lateral rail-ways. So far, therefore, from having cause to look upon my plan, as an unintentional repetition of that of De Solages, I had the additional pleasure to find, that I had vanquished difficulties, which had appeared insuperable, to one of the first engineers of Europe. As Bramah, in England, and Dearborn, in this country, had, in like manner, failed in applying Dr. Anderson's principle to the perpendicular lift, and had been compelled to have recourse to solid lateral counterpoises, to a single, instead of two locks, I conceived myself, from that moment, justified in believing, that I was the first who had

pointed out a practical mode of applying that beautiful and simple principle.

A short time since, I was informed, that an impression existed, that many of the points, on which I relied for the originality of my views, were to be found in the specification of a patent, taken out in England, by Fussell, in 1798, and published in the Repertory of Arts, for that year. As you may well suppose, I felt mortified at this intelligence, particularly as that work was within my reach, and had been consulted, occasionally, when the subject was first proposed to me. I had, however, soon ceased to make use of it, as I found a synopsis of every important paper, relating to this question, in the article CANAL, in Rees' Cyclopedia. On reference to Rees, which I had at hand, I discovered nothing to justify the impression that had been conveyed to me, as Fussell is merely quoted as the inventor of an abortive perpendicular lift. On consulting the original paper, however, in the Repertory, I found, what had before escaped me, namely, that he states, that in case the descent should be in *hard rock*, an inclined plane, with rail-ways, may be substituted for his vertical pit. I had not, before this time, perused the whole of Fussell's paper, probably, in consequence of my considering it, from its title, and the synopsis in the Cyclopedia, as referring to the lift alone; but, had I done so, it might have furnished me with a hint of the principle on which I proceeded, had I not previously obtained it from Dr. Anderson's paper, in the first volume of the same work. But in the manner of its application, connecting the cars, by a single chain passing over an inclined wheel, Fussell differs, *toto cælo*, from me. His words are, evidently, those of a person, pointing out a probable extension of his invention, without any precise idea of the manner in which it was to be, practically, effected; and, I do not see, with a gate, falling into a case *beneath* the car, how his locks could be set on an inclined plane, or their connexion effected practically; while the additional risk, created by the axle of the inclined wheel, which would, necessarily, be weak, and, the fact of his trusting to but one chain, would render it insecure, and dangerous, in the highest degree.

I have thus, sir, given you such a statement, as will enable you to judge how far I am entitled to any merit, in the plan of the inclined plane I have sent for exhibition; and I think you will from it be satisfied, that, while I must, as at present advised, concede to Fussell the claim of having first pointed out, that Dr. Anderson's principle was applicable to the inclined plane, as well as to the perpendicular lift, I am still entitled to the right of priority in every part of the model, that is essential to its success in practice, and to its safe and ready use; and moreover that where I trod in the same path with other persons, it was without a knowledge of their previous discoveries.

I am, Sir, your obedient servant,

JAMES RENWICK.

ANCIENT VASES.

(Continued from page 226.)

Although the black coating produced in this manner upon the surface of earthen vessels, agrees in many of its qualities with the varnish of the antique Grecian vases, and it is not improbable, that a similar substance, and a similar mode of painting, was used in their manufacture, yet the varnish prepared in the manner above described, differs from the ancient varnish in this respect, that it does not resist a very great degree of heat; nor have I as yet succeeded in my efforts to discover, by what means the faculty of sustaining the power of an intense heat, could be given to varnish prepared of *asphaltum*. However, it is evidently not impossible, that time may have done something in this respect, which art could not produce.

It is well known, that *asphaltum* and *naphtha* were among the substances known to the ancients, and that they were applied by them to various purposes. Pliny, in fact, relates, that inscriptions made with *Jet* (Gagates) upon earthen-ware, are not effaced. But, from what we learn with regard to this *Gagates* of Pliny, it is to be inferred, that it was not the *Jet* of modern times, but *asphaltum;* which renders it probable, that the art of making a coating for earthen-vessels of that substance, was known to the ancients. The varnish and paintings, indeed, which occur in the sepulchral vases of the Greeks, do not seem to have been applied by the Romans to earthen-ware manufactures; for no traces of them occur among the numerous remains of Roman pottery. A covering, however, in some respects similar to it, but consisting of vegetable pitch, was used by the Romans in their wine vessels, the preparation of which is accurately described by *Columella*. I do not doubt that a varnish made from *asphaltum*, in the manner above described, and the mode of painting founded upon it, to which the name of Enamelling is applied, might be used with advantage in modern pottery; as for ornamenting vessels, covering tiles, &c.

Besides the black varnish, some other colours are seen in Grecian and Etruscan sepulchral vases; for example, white, yellowish white, red, brown, rarely bluish-green or livid. In the vases whose paintings are made of the varnish itself, particular parts only of the paintings consist of these colours; for example, leaves, flowers, architectural ornaments, the drapery of figures, the wings of winged figures, horses, chariots, &c. In other vases, which are evidently covered with black varnish, certain ornaments are sometimes laid in upon it with other colours, especially white. The nature of these pigments is as follows: 1. They are, without exception, opaque, and belong to the paints, called in German, *Deckfarben*. 2. They seem prepared either from earth or metallic oxides; for example, the white pigments from argil; the red, from oxide of iron; the brown, from oxide of iron mixed with oxide of manganese. 3. They are not vitreous, but have an earthy aspect. 4. They are not intimately united with the baked clay; they fall off, and may easily be abraded; they are partly dis-

solved in acids. 5. They are usually laid upon the black varnish, which appears evident enough when particles of the paint have fallen off, or are abraded, by which the black varnish is discovered. From these properties, it may be inferred, that antique painted vases have not been baked in the same manner as our earthen-ware is, along with the pigments, but have had the pigments applied to them after being baked.

We shall now, in the *second* place, speak of the *mechanical method* in which the varnish and paintings have been applied. All that I have observed with regard to this matter, during a diligent examination of Grecian and Etruscan vases, as well as all that has already been observed by others, agrees well with the opinion expressed above, regarding the composition of the varnish.

Some antiquarians have thought that the paintings of the Grecian vases have been perfected by the assistance of the moulds to which our workmen gave the name of *Patrones*. Others have supposed, not that the whole paintings, but the ornaments, have been made in this way. I cannot, however, give my assent to these opinions. If the figures or ornaments had been perfected by the aid of moulds, vases would undoubtedly be sometimes found in the same place, with the same paintings. But although similar representations are not unfrequently seen in different vases, there have never, in so far at least as I know, been found two vases, whose paintings correspond in every respect, which has already been remarked by *Grivaud*. If the ornaments, which might have been made by means of moulds, more easily than the more diversified and complex figures, be attentively examined, certain irregularities and slight blemishes will often be found, which would undoubtedly have been avoided, if moulds had been applied in the painting of vases.

From certain marks to be observed in the paintings, and varnish of vases, it may be inferred, that the black paint has not always been applied once only, but sometimes repeatedly. The first coating is not always accurately covered by the succeeding one; nor is it rare to find different shades of colour in the same vase. The parts of vases not covered by the black varnish, very frequently are of a red colour, which is darker than the peculiar colour of baked clay, and has also a certain degree of lustre; properties which have probably been produced by a single application of a thin varnish.

In vases whose figures are of a black colour, the outlines have first been drawn with a pencil, and the minor parts of the figures then filled up with paint; a mode of painting which is plainly discernible, for example, in some Locrian vases. In vases which have red figures upon a black ground, a similar mode of painting is often observable. In them, the outlines of the figures are covered with diluted paint, and the filling up of the black ground, is then perfected. In some vases, the ground-colour does not completely touch these outlines; in some others, the ground-colour passes over the outlines here and there; sometimes connexions of the outlines are observed; defects which clearly show the mode of painting. It may also be recognized by the circumstance, that the black colour is less intense in the

places where the outlines have afterwards been covered by it, than in the other parts. According to the observation of *Meyer*, a first shading of the paintings with a red pigment, is rarely seen. In some vases, it is obvious that the outlines of the figures have been cut out with some sharp instrument. Instead of cut lines, dotted ones sometimes occur. *Jorio* has observed, that, in some vases, it is evident that the figures have been first painted naked, and afterwards covered with the drapery;—a mode of painting which was much in use even in the time of *Raphael*.

In vases with red figures upon a black ground, the internal delineation of some parts of the figures being of a deep colour, have undoubtedly been made, last. After the laying on of the black paint has been executed, other colours have sometimes been added to the paintings, as has already been noticed above. All the paintings of the ancient Grecian vases, have been done with a very fine pencil. If the black varnish has, in reality, been made in the manner above described, the greatest quickness has been requisite in applying it, according to the experiments described by me; and, therefore, the nicest address in the workman. A blunder committed, if it could not be covered over, was irreparable. Although a wonderful steadiness and sureness of hand is manifest in the paintings of vases, yet blemishes produced by haste, are not unfrequently seen.

We are, in the *third* place, to treat more especially of the operations required, after the application of the paints, for finishing the paintings.

We have shown above, that it is probable vases have not, after being first covered with a coating of varnish and other pigments, been again baked, like our modern glazed earthen-ware. Consequently, no further operations were necessary for finishing them. In some vases, however, engraved delineations occur, which penetrate through the black varnish, and present the clay colour of the base; in others, similar lines are seen, which pass through the pigments laid upon the black varnish, and lay the latter bare. These ornaments, which are of rare occurrence, could only have been produced, after the pigments had been applied, by means of a sharp stile.

In some vases there occur letters, either painted or cut out with a sharp instrument, which either exhibit the name of the painter, or notify the object of the painting.

The painted letters have been done in various ways. 1. In the most ancient vases they are black, upon a red ground. 2. In more recent ones, the ground on which they are laid, is sometimes white or red; or, 3. In the same manner as the figures, they are circumscribed by a black ground, and have the colour of burnt clay. The engraved letters upon some of the more ancient vases, are found either in the red ground, or in the black varnish.

ON ENGRAVING.

(From the Mechanics' Gallery. By C. F. Partington.)

(Continued from page 312.)

On Aqua tinta.

Having given a general idea of this art, we shall mention some particulars necessary to be attended to, in order to ensure success in the operation. The spirits of wine used for the solution, must be highly rectified, and of the best quality. What is sold in the shops generally contains camphor, which would entirely spoil the grain. Resin, Burgundy-pitch, and Gum-mastich, when dissolved in spirits of wine, produce grains of a different appearance and figure, and are sometimes used separately, and sometimes mixed in different proportions, according to the taste of the artist, some using one substance, and some another. In order to produce a coarser or finer grain, it is necessary to use a greater or smaller quantity of resin; and to ascertain the proper proportions, several spare pieces of copper must be provided, on which the liquid may be poured, and the grain examined, before it is applied to the plate to be engraved. After the solution is made, it must stand still, and undisturbed, for a day or two, till all the impurities of the resin have settled to the bottom, and the fluid is quite pellucid. No other method of freeing it from those impurities, has been found to answer; straining it through linen or muslin only fills it with hairs, which are ruinous to the grain. The room in which the liquid is poured on the plate, must be perfectly still and free from dust, which, whenever it falls on the plate, while wet, causes a white spot, which it is impossible to remove without laying the grain afresh. The plate must also be previously cleaned, with the greatest possible care, with a rag and whiting, as the smallest stain or particle of grease produces a streak or blemish in the grain. All these attentions are absolutely necessary to produce a tolerably regular grain; and, after every thing that can be done by the most experienced artists, still there is much uncertainty in the process. They are sometimes obliged to lay on the grains several times before they produce one sufficiently regular. The same proportions of materials do not always produce the same effect, as it depends in some degree on their qualities; and it is even materially altered by the weather. These difficulties are not to be surmounted but by a great deal of experience; and those who are daily in the habit of practising the art, are frequently liable to the most unaccountable accidents. Indeed it is much to be lamented, that so elegant and useful a process, should be so extremely delicate and uncertain.

It being necessary to hold the plate in a slanting direction, in order to drain off the superfluous fluid, there will naturally be a greater body of the liquid at the bottom than at the top of the plate. On this account, a grain laid in this way is always coarser at the side of the plate that was held lowermost. The most usual way is, to keep the

coarsest side for the fore-ground, that being generally the part which has the deepest shadows. In large landscapes, sometimes various parts are laid with different grains, according to the nature of the subject.

The finer the grain is, the more nearly does the impression resemble Indian ink, and the fitter it is for imitating drawings: but very fine grains have several disadvantages; for they are apt to come off before the aqua fortis has lain on long enough to produce the desired depth; and as the plate is not corroded so deep, it sooner wears out in printing; whereas coarser grains are firmer, the acid goes deeper, and the plate will throw off a great many more impressions. The reason of all this is evident, when it is considered, that in the fine grains the particles are small and near each other, and consequently the aqua fortis, which acts laterally as well as downwards, soon undermines the particles, and causes them to come off. If left too long on the plate, the acid would eat away the grain entirely.

On these accounts, therefore, the moderately coarse grains are more sought after, and answer better the purpose of the printer, than the fine grains which were formerly in use.

Although there are considerable difficulties in laying, properly, the aqua tint grain, yet the corroding the copper, or biting-in, so as to produce exactly the tint required, is still more precarious and uncertain. All engravers allow that no positive rules can be laid down, by which the success of this process can be secured; nothing but a great deal of experience and attentive observation can enable the artist to do it with any degree of certainty.

There are some hints, however, which may be of considerable importance to the person who wishes to attain the practice of this art. It is evident, that the longer the acid remains on the copper, the deeper it bites, and consequently the darker will be the shade in the impression. It may be of some use, therefore, to have several bits of copper laid with aqua tint grounds, of the same kind to be used in the plate, and to let the aqua fortis remain for different lengths of time on each; and then to examine the tints produced in one, two, three, four minutes, or longer. Observations of this kind frequently repeated, and with different degrees of strength of the acid, will at length assist the judgment in guessing at the tint which is produced in the plate. A magnifier is also useful to examine the grain, and to observe the depth to which it is bit. It must be observed, that no proof of the plate can be obtained till the whole process is finished. If any part appears to have been bit too dark, it must be burnished down with a steel burnisher; but this requires great delicacy and good management not to make the shade streaky; and as the beauty and durability of the grain are always somewhat injured by it, it should be avoided as much as possible.

Those parts which are not dark enough, must have a fresh grain laid over them, and be stopped round with varnish, and subjected again to the aqua fortis. This is called re-biting, and requires peculiar care and attention. The plate must be very well cleaned out with turpentine before the grain is laid on, which should be pretty

coarse, otherwise it will not lay upon the heights only, as is necessary, in order to produce the same grain. If the new grain is different from the former, it will not be so clear nor so firm, but rotten.

We have now given a general account of the process of engraving in aqua tint, and we believe that no material circumstance has been omitted, that can be communicated, without seeing the operation: but after all, it must be confessed, that no printed directions whatever can enable a person to practise it perfectly. Its success depends upon so many niceties, and attention to circumstances apparently trifling, that the person who attempts it must not be surprised if he does not succeed at first. It is a species of engraving, simple and expeditious, if every thing goes on well; but it is very precarious, and the errors which are made are rectified with great difficulty.

It seems to be adapted chiefly for imitation of sketches, washed drawings, and slight subjects; but does not appear to be at all calculated to produce prints from finished pictures, as it is not susceptible of that accuracy in the balance of tints necessary for this purpose. Nor does it appear to be suitable for book-plates, as it does not print a sufficient number of impressions. It is, therefore, not to be put in competition with some other modes of engraving. If confined to those subjects for which it is calculated, it must be allowed to be extremely useful, as it is expeditious, and may be attained with much less trouble than any other mode of engraving.

FROM THE GLASGOW MECHANICS' MAGAZINE.

ESSAYS ON BLEACHING.

By James Rennie, A. M. Lecturer on Philosophy, &c. &c. London.

No. I.

Continuation of the History of the Art.

We have mentioned the improvement which Mr. Henry made in the application of chlorine, by the intervention of a calcarious mixture applied to the cloth. This, it must be confessed, was a considerable advance towards perfection; but was found to be both inconvenient and dangerous to the workmen, from the disengaged state in which the gas remained in the vessel, before combining with the lime; while the chance of the goods being unequally exposed, rendered it somewhat uncertain. It was reserved for Mr. Tennant, of Glasgow, to remove these difficulties, by the discovery of a method of combining chlorine with lime in a separate vessel, which contained lime suspended in water by mechanical agitation. The redundant lime was allowed to subside, and a clear liquid, which was a solution of the oxymuriate of lime, was applied properly diluted to the purpose of bleaching. "It is worthy of remark," Dr. Brewster observes, "that

this combination, even when the chlorine is perfectly neutralized, has the power of bleaching light or thin goods, though it is much less active in discharging some vegetable colours." Hence this method has certainly a great advantage over all former ones, in the facility and safety of its application, especially to coloured goods, which would have their colours discharged by the contact of either the acid or the quicklime, in an uncombined form. This discovery was secured to Mr. Tennant by a patent, dated January 30th, 1798, which has since been set aside by a legal decision.

Nearly about the same time, the French chemists, and practical bleachers, made considerable improvements on the mode of Berthollet, chiefly in the apparatus, and in the use of a combination of potash with chlorine. These are detailed in a work by Des Charmes, which, as a practical treatise, is above all praise, and to which I hold myself greatly indebted for important information. Sometime previous to this also, the trustees for the linen and hempen manufactures in Ireland, published a report of experiments to ascertain the merits of the several bleaching liquids prepared from chlorine, which contains some useful knowledge, and rationales, not before published. This was followed, in the same quarter, by Kirwan's accurate experiments upon the different alkalies used in bleaching, who first showed the bleacher how to ascertain the qualities of those important agents. Mr. Higgens of Dublin, also, whose chemical abilities are well known, discovered a new agent, namely, sulphuret of lime, which he recommended in a small work on the theory and practice of bleaching, published in 1799. This has never come into general use, so far as I can learn. There seems, indeed, to be some peculiar nicety in the management, which renders its application, in the hands of the inexperienced, liable to uncertainty. From this circumstance, some of the bleachers of Glasgow who attempted to introduce it, had their goods corroded and destroyed.

At a still later period, say 1800, Chaptal made several experiments on the application of alkaline vapours to bleaching and washing. These were published in the several Scientific Journals of Europe, and detailed at some length by D'Orelly, in his *Essai sur le Blanchament.*

Mr. Tennant, however, still retains a patent for manufacturing the dry oxymuriate of lime, the discovery of which is among the latest and most interesting improvements in chemical bleaching, as it acts with greater safety and effect, while it is not so liable as the other preparations of chlorine, to give out the deleterious gas, which, in the old mode, was so apt to injure the workmen. It can also be carried to a distance with greater ease than any of the liquid combinations, and Mr. Tennant accordingly supplies the bleachers of Ireland and England with oxymuriate of lime, as well as those in the immediate vicinity of his manufactory.

The oxymuriate of magnesia has very recently been recommended by Sir Humphrey Davy, and Mr. Ramsay, of Glasgow, for clearing the whites of printed calicoes, and promises to be an improvement of considerable importance.

In the apparatus of bleaching, there have lately been radical and important alterations made, some of which are of great utility. The whale boiler may be mentioned as an example of these. It is an ingenious substitute for the old bucking apparatus, and is well deserving of attention. It has been but lately introduced in the bleaching works around Glasgow: its utility, however, I am persuaded, will soon bring it into general use. In proportion, indeed, as the apparatus of chemistry, considered generally, is improved, so will the apparatus in bleaching.

But it is not unlikely that this art may soon be altogether superseded, at least in so far as regards the bleaching of linen goods; if the mode of manufacturing flax, invented by Mr. Lee, ever come to be generally adopted, or, if it be true, that when flax is so manufactured, the linen produced from it can be made sufficiently clear and white by simple washing. It was about two years ago that Mr. Lee took out a patent for obtaining hemp and flax directly from the plants, by a new method. He neither steeps his flax nor spreads it on the grass. When the plant is ripe, and it must be allowed to ripen more perfectly than when the common method is followed, it is pulled in the usual way. It is then thrashed by placing it between two grooved wooden beams armed with iron. One of these is fixed, the other is suspended upon hinges, and is made to impinge with some force on the fixed beam; the grooves in the one beam corresponding with flutes in the other. By a mechanical contrivance, almost exactly similar, the woody matter is beaten off, and the fibres of flax left. By passing these through hackles, varying progressively in fineness, the flax is very speedily dressed and rendered proper for the use for which it was intended. The advantages of this process are manifold. The expense of steeping and spreading is saved; a much greater produce of flax is obtained; it is much stronger; the fibres may be divided into much finer fibrillæ, so as to obtain at once, and in any quantity, flax, fine enough for the manufacture of lace. But the greatest advantage is the ease with which it may be bleached. For the colouring matter not being chemically combined with the fibre, as is the case with what has undergone the steeping process, there is nothing more required to whiten it than washing it well in pure water. Dr. Thomson, whose opinion on this subject is of great weight, says, (Ann. Phil. VI. 230,) that he considers this invention as the greatest improvement ever introduced in the linen business, and, *as likely to occasion a total change in the whole of our bleach-fields!* I am of opinion, however, that this will not altogether preclude the necessity of bleaching, however much it may facilitate it; for cotton, which is never steeped, and, besides, is much whiter naturally than the best flax, requires to undergo the bleaching process.

ENGLISH PATENTS.

To JOHN GEORGE BODMER, *of Oxford-street, Charlton Row, in the parish of Manchester, in the county of Lancaster, Civil Engineer, for his invention, and perfection, of certain improvements in the machinery for cleansing, cording, drawing, roving, and spinning of cotton and wool.*

The improvements proposed under this patent, have two principal features, viz. 1st, a more advantageous mode than has heretofore been practised, of preparing and supplying the rovings of cotton or wool, for the feeding of mules, throstles, and other spinning machines; and, 2ndly, in certain contrivances for producing the requisite movements, for running backward and forward the carriage of a mule, and giving the variable velocities to the spindles in the different parts of the operation.

The patentee has extended his specification to a most immoderate length, having filled *thirty-four closely written skins of parchment*, with the details of his contrivances, which are, of course, much too elaborate for us to repeat. Our readers will, however, lose nothing material, in our version of the subject, for this lengthened treatise consists principally in descriptions of well known machines, to which the improvements are proposed to be adapted.

In the first place, the invention is described as connected with a blowing or scutching machine, in which the rough cotton or wool is to be cleansed, preparatory to spinning; that is, divested of its dust, and other impurities. The material about to be operated upon, (having been previously opened, or separated, by the means usually employed in the first process of preparation,) is passed by an endless web to a pair of guide rollers, which conduct it forward through three pairs of drawing rollers, where the filiments are extended, and the material drawn out about fifteen times, as in the ordinary drawing process. From thence the filiaments pass through the blowing, or scutching apparatus, where they are scraped, or beaten, by a series of indented ledges, standing in a radiating position, upon the periphery of a rapidly revolving drum. By these means, any dirt which adhered to the cotton, or wool, is beaten off: and at the same time, a very strong current of wind, produced by fans, within the drum, acting upon the cotton or wool, blows the dust through a grating below, and thereby cleanses the material thus operated upon.

The force of the wind produced by the rotation of the drum, carries the light filiaments of cotton or wool forward, into a chamber, which, from the wind passing up it, the patentee calls a chimney; this chimney is divided into several compartments, by vertical partitions, and hence the cotton is separated into as many distinct breadths of sliver, as there are compartments. The extreme ends of these breadths of sliver, having been carried forward, by the current of wind, into the chimney, now fall upon traversing endless bands, and are, by means of those bands, conducted to another system of drawing rollers.

where the filiaments are further drawn, and elongated from nine to twelve times.

At this point of the operation, the first improvement above-mentioned takes place, which consists in the employment of a series of guide rollers, placed at an oblique angle to the drawing rollers, by means of which, the course of the filiaments of cotton or wool, conducted from the drawing rollers through spouts, is made to deviate from its previous straight direction, and being from them carried downwards on to another traversing web below, the lengths of filiament are made to proceed in a horizontal course, at right angles, to that in which they had been drawn, and are ultimately coiled round, or lapped with the cloth that brings them forward on to a cylindrical roller. The particular object of turning the directions of the filiaments, is stated by the patentee to be this—"If an inequality of thickness takes place in the sliver, by turning it at right angles, the inequality becomes divided."

In a similar way, the slivers from a number of carding engines may be conducted off at right angles, by means of endless bands, and be delivered to a lapping engine, for the purpose of coiling them upon a cloth, round a cylindrical roller; the carding engines being all connected together, and actuated simultaneously by straps or bevel gear.

The rollers, when thus covered with the cloth, and the rovings of cotton or wool, are to be placed in convenient situations for feeding the drawing rollers and spindles of mules, throstles, or other spinning machines, instead of feeding the said machinery from copts, or bobbins, as usual; and for the better effecting of that object, the roller thus covered with cotton or wool, is to be placed upon two other revolving rollers, which will cause it to turn round by the friction of the surfaces, and by that means, uncoil and deliver the rovings, as may be required.

The second feature of the invention, as we stated above, consists in a method of moving the carriage of the mule backward and forward. The patentee precedes the explanation of this contrivance, by a description of the ordinary mode of working the mule, and then states, that instead of the usual band and wheel employed for driving the carriage, he connects the carriage to the standard, or frame, by means of a series of levers, combined in the way of lazy-tongs: one end of the lazy-tongs being attached to the carriage, and the other to the standard.

At the end of the axle of the delivering rollers that receive and guide the rovings, there are some bevel-wheels attached, which, as they revolve, move a cam, or fusee, and this cam, acting against the legs of the lazy-tongs, according to its position, opens or shuts them, and, consequently, causes the carriage to advance, or recede, as the lazy-tongs elongate or collapse. Notwithstanding the extravagant length of the specification, this part of the invention is not described in the clearest possible way. The intention and action of such an apparatus, may, however, be easily understood, and as to the details of the other parts of the machinery, they appear to be all of them

common to ordinary spinning apparatus, and, therefore, need not be enlarged upon here.—*Enrolled March*, 1825.

[*Lon. Jour. of Arts and Sciences.*

Specification of the Patent granted to THOMAS HANCOCK, *of Goswel Mews, in the parish of Saint Luke, Old-street, Middlesex, Patent Cock Manufacturer, for a new or improved manufacture, which may in many instances be used as a substitute for leather, and otherwise.* Dated March 15, 1825.

To all to whom these presents shall come, &c. &c. *Now know ye*, that in compliance with the said proviso, I, the said Thomas Hancock, do hereby declare that the nature of my said invention, and the manner in which the same is to be performed, is described and ascertained as follows, (that is to say:)—My said invention consists in filling, saturating, and combining various fibrous substances, in their manufactured and unmanufactured state, with a composition which leaves to the fibres sufficient flexibility, and at the same time unites and consolidates them into one mass, thereby increasing their strength and durability, and producing, by these means, a manufacture which may be in many instances substituted for leather, and be applied to other useful purposes, such as soles for shoes and boots, hose, pipes, pails, and other articles which have heretofore been made of leather; and also to other useful purposes, such as the roofs of virandas, corn and flour sacks, packing cloths, and tarpaulings. The fibrous substances I employ in this manufacture are wool, cotton, hair, silk, flax, hemp, carded, combed, or hackled, and combined with the same substances, woven and manufactured. As the same process is applicable to all the combinations, it will be necessary to describe the method I pursue in one case only, as any variation may be made in arranging the different substances, at the discretion of the operator:—I take a piece of cotton cloth, of any convenient size, and strain it on a board, and spread over it, with a spatula, or other convenient instrument, a full coating of one of the compounds to be hereafter described. I then spread on, or over, the compound a layer of carded cotton, somewhat similar to the article known by the name of wadding, spreading over this again another piece of cotton cloth, prepared as the first. I then submit the whole to sufficient pressure between boards, or plates of metal, either passing them through or between rollers or otherwise, to force the composition quite through the layer of carded cotton. I then carefully remove it from the boards or plates, and leave it to dry either in the open air, or in a warm room, heated to eighty or ninety degrees of temperature, and proceed to make others in the same manner. When I perceive that they are nearly or quite dry, I again submit them to the press; or if one of these strata is not sufficient to make up the thickness I require, I put two, three, four, or more together, spreading the said compound on the surfaces again if necessary,

and increasing the pressure. After they have been in the press some hours, they may again be exposed to the air, or returned to the warm room, to complete the drying, and if necessary, pressed again. When I wish to have the carded cotton for either or both surfaces, I carefully separate, at the end of two or more pressings, the last layer or layers of cloth from the cotton below it, soon after I take it out of the press, as it will then separate, and proceed as before described. In this manner I introduce into this manufacture, hair, wool, silk, hemp, and the like, or any mixture of these fibrous substances, or any or all of them, mixed with chopped hemp or tow, and carded together; or I hackle or comb hemp or flax, and lay the fibres parallel with each other, and combine any intermixture of these different materials with the different kinds of manufactured wool, silk, linen, cotton, and the like, according to the purpose to which the article is to be applied, or as economy may dictate. For soles of shoes and boots, I prefer wool, hair, and cotton, in about equal proportions. For hose, pipes, pails, and accoutrements, chopped hemp, tow, and cotton. I prefer the woven materials to be made of wool or cotton, and these of an open, loose, and coarse texture, excepting where it is intended for a finer surface; in such cases I choose the fabric of a finer quality. If the article is required to have a smooth surface, I produce it by using polished metal plates, the last time the article is pressed. I make the compound, or compounds, with which I unite or combine the said substances, as follows:—(No. 1.) I take two pounds of caoutchouc, dissolved in one gallon of equal parts of oil of turpentine, and highly rectified coal tar oil, six ounces of black resin, two pounds of strong glue size, and one pound of ochre, powdered pumice, or whiting, and mix the whole together; or (No. 2.) one pound and a half of caoutchouc, dissolved as before stated; one pound of strong glue size. I melt and mix the resin and size in a water or steam bath, and then add the other ingredients, stirring the whole until it is mixed throughout. The solution of the caoutchouc is expedited by a water or steam bath, and the undissolved portions may be separated by straining it through a fine wire or other sieve. The mixture (No. 1.) is applicable to articles where stiffness and cheapness are required. No. 2, is preferable when pliancy and strength are more required. But I think it proper here to state, that the proportions above mentioned may be varied according to the different applications of the article to be manufactured. If varied qualities of stiffness, or cheapness, should be desired, the proportions of size and whiting may be increased till they make up one-third of the mass. If flexibility be required, the quantity of dissolved caoutchouc in the compound No. 2, may be increased, and especially where great strength and pliancy are required. This last is also preferable for articles that are to be much exposed to the weather.

[*Repertory of Patent Inventions.*

Patent granted to THOMAS MUSSELWHITE, *of Devizes, Saddler, for improvements in the manufacture or construction of collars for horses, or for other animals.* Dated July 16, 1825.

The collar described in the specification of this patent, differs from those in common use; first, in being made to open at the top, to facilitate its being placed on the horse's neck; secondly, in having two oval iron bows introduced in the external part of the stuffing, to make it preserve its shape, more unalterably; thirdly, in a cane bow, attached to a piece of leather, properly shaped, being fixed in it close before the anterior iron bow, to keep the hames more firmly in their place; and fourthly, in having two large pieces of cork, formed so as to fit the shoulder of the horse, introduced, one at each side, into the stuffing.

The fore iron bow, is fixed in front of the collar, so as to lie partly under the hames; and the back iron bow, which is made considerably stronger is placed two or three inches behind the first, parallel to it, and nearly where the collar begins to bend round sideways to the horse's neck. The two iron bows are kept together by an iron pin, rivetted at right angles to the bottom of the front bow, which passing backwards through a hole in the bottom of the other bow, is there pressed against it by a nut, that is made to screw on it for this purpose; and behind the nut a ring is represented in the drawings of the specification, though not mentioned in the description; the top extremities of the back bow are formed into two loops, through which a strap runs, that by its buckle closes it tight, above the horse's neck; and the upper ends of the front bow are either closed by a "turn buckle," or some similar means. The purpose of the other parts mentioned, are explained above, and ample directions are given by the patentee for shaping the various pieces of leather, and putting them together, which, with these altogether, constitute the collar. We cannot say so much for an instrument intended to take measure of horses' necks, which is described in the specification in too general terms, to convey any precise ideas of its formation, little more being said of it, but that it is composed of curved pieces of brass, graduated so as to assist in recording the exact form of the neck, and that the patentee finds it very useful for this purpose.

It appears to us that this collar is well contrived to preserve its shape, and be very compact, firm, and durable. The addition of the cork to the stuffing, seems a judicious improvement, calculated not only to maintain the form of this part, but to keep the horse's neck cool, which we think a material consideration. As no joints are represented in the iron bows, we suppose they must open by their elasticity; but joints at their lower parts, where the pin passes through them, would also have the same effect.

Good, well fitting collars, are of more consequence than is imagined, there being great reason to suppose that the lives of horses have often been sacrificed to defects in these particulars; which making them press too much on the great veins that lead from the head of the

animal, when the draft is severe, cause the blood to be forced too largely into the brain, where, if it does not occasion apoplexy, as not unfrequently happens, it produces other disorders, no less fatal in the end.

Collars may be also contrived so as to throw the principal pressure of the draft, on the front of the horse's breast, below the windpipe, which would have the good effect of preventing compression of the great veins, as well as of this latter organ; and we refer for a plan for this purpose, to our 17th vol. Second Series.—[*Ibid.*

Specification of the Patent granted to JOHN MARTINEAU, *the younger, of the City Road, Middlesex, Engineer, and* HENRY WILLIAM SMITH, *of Laurence Pountney Place, London, Esq., for certain improvements in the manufacture of steel. Communicated to them by a Foreigner.* Dated October 6, 1825.

To all to whom these presents shall come, &c. &c. *Now know ye*, that in compliance with the said proviso, I, the said John Martineau, the younger, do hereby declare the nature of the improvements, so communicated to us as aforesaid, to consist in adding to, and mixing, or combining with, blister steel, or such other steel as is ordinarily used in cast steel works, such alloys, and in such proportions as will greatly improve the quality of the said steel, and will enable the manufacturer to produce in goods made of the said alloyed steel, the beautiful wavy appearance exhibited on the best Damascus sword blades. This said alloyed steel, we call meteor steel; and, in further compliance with the said proviso, I, the said John Martineau, the younger, do hereby describe the manner in which the said improvements so communicated to us, as aforesaid, are to be performed as follows (that is to say): twenty-four parts of zinc, four of purified nickel, and one of silver, are put into a black lead, or other refractory crucible, the surface being covered with charcoal powder, the cover is to be luted on, and the whole subjected to the heat of a steel furnace, until it is fused; the mixture, when melted, is then poured out into cold water, so as to render it brittle, and more easy to pound into small pieces for use. This we call meteor powder, and although we have found these proportions of the different metals to be the best for general purposes, yet we do not confine ourselves to these precise quantities, a small variation affording a scarcely perceptible difference in the results. Having produced our meteor powder, in manner aforesaid, we next proceed to make our meteor steel; in the process of making which, we charge our crucibles, which are of the usual size, form, and fabric, with the following ingredients, and in the following proportions, (that is to say,) twenty-four pounds of blister steel, or such other steel as is used in cast steel works, eight ounces of meteor powder, pounded very small, six ounces of pounded chromate of iron, one ounce of charcoal powder, two ounces of quick-

lime, and two ounces of porcelain clay. The above proportions produce a steel of an excellent quality, and capable of exhibiting the said wavy appearance in a beautiful manner, but we vary somewhat the proportions of meteor powder, according as more or less of this wavy appearance is required. The quantity of charcoal must also be somewhat varied, according as a harder or softer steel is required, and according as the blister, or other steel used for charging the crucible, is more or less converted; these are points which may be safely left to the experience of any ordinary steel caster. The quicklime and porcelain clay being only used as fluxes, may be varied in quantity, without injuring the process, but the proportions hereinbefore described, are the best we have as yet discovered. The furnaces and crucibles, at present in use in cast steel works, may be used in the manufacture of the meteor steel, and the said steel, when made as aforesaid, may be cast and tilted in the usual manner. In order to draw out and exhibit the said wavy appearance upon any article manufactured with this steel, the surface, when polished, should be rubbed over with any acid which readily acts upon steel, and according as the wavy lines are required to be more or less conspicuous, so the surface is to be kept moistened with the said acid for a longer or shorter period. As soon as a sufficient effect is produced, the acid must be carefully washed off; various acids will answer for this purpose, but we prefer a mixture of one part nitric acid to nineteen parts of distilled or French vinegar. Now, whereas, we do not claim exclusive right or privilege to any of the apparatus hereinbefore described, as used in the manufacture of the said meteor steel, but only to the mixed metal produced by the combination of steel, zinc, purified nickel, and silver, and chromate of iron, in manner hereinbefore described, and which mixture constitutes the said improvements so communicated to us, as aforesaid; and such improvements being, to the best of our knowledge and belief, entirely new, and never before used; I, the said John Martineau, the younger, do hereby declare this to be our specification of the said improvements, and that I do verily believe this our said specification doth comply in all respects fully with the proviso in the hereinbefore recited letters patent. Wherefore, we do hereby claim to maintain exclusive right and privilege to the said improvements.

In witness whereof, &c.—[*Ibid.*

FOR THE FRANKLIN JOURNAL.

MECHANICAL JURISPRUDENCE.—No. XI.

BY PETER A. BROWNE, Esq.

On the law of Patents for new and useful Inventions.

Under the second general rule, with respect to patents, namely, that the invention, or discovery, must be *new*, there are several particular rules, which require attention.

1. *The inventor must not allow it to be used by any one, before he takes out his patent.*

My Lord Coke says, (3 Inst. 184,) "A patent must be of such manufacture, or process, as no other did, at the time of making the letters patent, use; for though it be newly invented, yet, if any other did use it, at the time of making the letters patent, it is void, by the statute."

2. *The inventor cannot make sale of the article invented, or discovered.*

In the case of Wood v. Limmer, 1 Holt's N. P. Reports, 58, which related to a patent for a new mode of making verdigris, one of the objections was, that the invention was in public sale, by the patentee, before the grant of the patent; and Gibbs, Chief Justice, on that occasion, said, "Some things are obvious as soon as they are made public; of others, the scientific world may possess itself by analysis; some inventions almost baffle discovery. But to entitle a man to a patent, the invention must be *new to the world.* The *public sale* of that, which is afterwards made the subject of a patent, *though sold by the inventor only*, makes *the patent* void."

3. *It will not alter the case if it has been used in secret.*

In the case of Tenant's patent, for a bleaching liquor, Lord Ellenborough non-suited the plaintiff, and one of the grounds was, that the process had been known five or six years before, to five persons, and had been by them used in secret. See Davis on Patents, 429.

4. *In the United States, the discovery should be unknown, and not used as the invention of any other than the patentee, before the application for a patent.*

Huntington sued Moore in the Circuit Court of the United States, for the Southern District of New York, in April, 1824, for an infringement of a patent issued to the plaintiff in May, 1822, for an improvement in the stop-cock. Evidence was given by the plaintiff, showing the time of the invention to be September, 1815. It appeared that the plaintiff had taken out a patent, in 1816, for "*an improved block-tin stop-cock,*" the description of which corresponded with the one in the patent of 1822; but, in the former patent, the particulars claimed, were not designated, as done in the latter. It also appeared, that certain parts of the instrument, described generally, as part of the instrument in both patents, but not claimed in the patent of 1822, as improvements of the patentee, had been in use prior to the patent of 1815.

The defendant moved for a non-suit, and one ground was, "that the instrument had gone into use before the date of the patent of 1822, on which the suit was brought."

Judge Thompson, after expressing a wish that these questions, which he considered of much importance and difficulty, had come before him in a way which would have allowed more time for consideration, proceeded to express his opinion to the following effect.

He stated the first question to be, whether the fact, that the invention had been introduced into use by the patentee himself, as his

invention, prior to the application for the patent, rendered the patent invalid.

That it appeared to be settled law in England, that if an invention had been introduced into use by the patentee himself, and made known, and used by others, before the date of the patent, such disclosure, and use, would destroy the patent.

That there was, however, a difference between the English law, and the acts of Congress, on this subject.

In the English statute, it is stated precisely, from what period the fourteen years are to commence—they are to run from the date of the patent; there is no such phraseology in the act of Congress. That the English statute, speaks of the invention to be patented, being such as others before the date of the patent, shall not use; and, consequently, if a patentee in England has so disclosed his invention, as that it be put in use before the date of the patent, he is not entitled to the patent. Our acts do not contain these provisions.

That there was some incongruity in the phraseology of our patent law of 1793; that it was inartificially drawn, in several parts, and that a correct interpretation of it, required the general scope and object of the law, and all the clauses, to be taken into view together. That if no other part of the act than the first section were to be read, it would seem to preclude a patent for any invention used before the application for a patent; but that, taking a general view of the clauses of the act, and of its object, he thought that this section must be controlled by the other parts of the act. That, as it respected the patentee, the great object of the law was, to secure to inventors the benefit of their inventions, for fourteen years; the third section, prescribing the oath to be taken, only speaks of the applicant being the true inventor; it says nothing about the invention not having been in use before the application. So also the sixth section, which specifies the causes for which a patent may be declared void, shows the great object of inquiry to be, whether there was a prior use of the improvement; prior to what? Prior to the invention of the patentee. The same remarks are applicable to the tenth section; and, indeed, such seems the fair import of all the sections of the act of 1798, but the first. He therefore thought, that the first section should be construed in connexion with the other parts of the act, to mean, that the improvement, or discovery, should be unknown, and not used as the invention of any other than the patentee, before the application for a patent.

5. *According to the British laws, a patent may be granted to the first inventor, if the invention be new* IN ENGLAND, *though the thing was before practised* BEYOND SEA.

This arises upon the peculiar wording of the statute, which speaks of new manufactures *within the realm.* The case of Edgeberry v. Stevens, 1 Salkeld, 447, and Combuback, 84, before cited, establishes this point.

The words of the act of Congress are different from those of the English statute. The first section says, "Any *new* and useful art, &c., *not known, or used, before the application.*" The sixth section

declares, "that, if the defendant, in any action brought for a breach of the patent, shall prove that the thing, thus secured by patent, was not originally discovered by the patentee, *but had been in use*, or *had been described in some public work, anterior to the supposed discovery of the patentee*, judgment shall be rendered for the defendant."

6. *The words in the act are general, as to place; and, therefore, in the United States, no patent is valid if the thing patented has been in use, in* THIS, *or any* FOREIGN COUNTRY, *or has been described in an American, or foreign public work, prior to the time of the supposed discovery.*

Oliver Evans instituted a suit against one Eaton, for a violation of his patent right for his improvement in the art of manufacturing flour, by means of an elevator, conveyer, hopperboy, drill, and kill drier. The defence principally relied on, was, that the hopperboy had been used in certain mills in the United States, anterior to the supposed invention. The plaintiff gave evidence of his discovery in 1783, and of its being brought into use in 1785. The defendant produced a number of witnesses, who described a machine, called Stouffer's machine, or hopperboy, which had been in use, in many mills, from the year 1764, and which, they deposed, was the same as the hopperboy.

The plaintiff contended, that it was not necessary that he should be the *first* discoverer, if he was the real *bona fide* discoverer, without knowing that a similar discovery had previously been made; this, he argued, was clearly the meaning of the word "true," in the tenth section of the act of Congress, with which, he said, the word "original," in the sixth section, is synonymous. That the word "first," which was used in the British statute, was, no doubt, dropped intentionally by Congress.

But Washington, Justice, in his charge to the jury, said, "The discovery must be not only useful, but *new*. It must not have been *known*, or *used, before, in any part of the world*. It is contended by the plaintiff's counsel, that the title of the patentees cannot be impeached, unless it is shown, that they knew of a prior discovery of the same art, machine, &c.; and, that true, and original, are synonymous, in the intention of the legislature.

"As it is not pretended that true, and original, mean the same thing in *common parlance*, I proceed to inquire, whether the *legislature* intended to use them as such. As to this, there can scarcely be two opposed opinions. The first section, referring to the allegations of the applicant for a patent, speaks of a discovery, as something not known or used before the application. And in the sixth section, it is declared, that the defendant may give in evidence, that the thing secured by patent, was not originally discovered by the patentee, but had been in use, or had been described in some public work, anterior to the supposed discovery. Now, if *original* does not mean *first*, the preceding expressions, in the first and sixth sections, most certainly do."

This case was afterwards brought before the Supreme Court of the United States. 3 Wheaton's Reports, 454. Chief Justice Marshall

(page 513) delivered the opinion of the Court, on this point, as follows:—"The plaintiff has also contended, that it is not necessary for the patentee to show himself to be the *first* inventor, or discoverer. That the law is satisfied, by his having invented a machine, although it may have been previously discovered by some other person.

"Without a critical inquiry into the accuracy with which the term invention, or discovery, may be applied to any other than the *first* inventor, the Court considers this question as completely decided by the sixth section of the general patent act.

"That declares, that 'if the thing was not originally discovered by the patentee, but had been in use, or had been described in some public work, anterior to the supposed discovery of the patentee, judgment shall be rendered for the defendant, and the patent declared void.'

"Admitting the words '*originally discovered*,' to be explained, or limited, by the subsequent words; still, if the thing *had been in use*, or had been *described in a public work*, anterior to the supposed discovery, the patent is void. It may be that the patentee had no knowledge of this previous use, or previous description; still his patent is void: the law supposes he *may* have known it."

7. *Though the law requires, that the invention shall be new, yet a patent will be available, for a machine comprehending a* NEW COMBINATION *of parts, although all the parts may have been* REPEATEDLY *used in former machines.*

In Boulton and Watt v. Bull, Buller, Justice, observes, that "mechanical and chemical discoveries all come within the description of manufactures, and that it is no objection to either of them, that the *articles* of which they are composed, were known, and were in use before, provided the *compound article*, which is the object of the invention, is *new*."

In 1803, Huddard sued Grimshaw, in the King's bench of England, to recover damages for the violation of a patent for a new mode, or art, of making great cables, and other cordage, so as to obtain a greater degree of strength therein, by a more equal distribution of the strain upon the yarns.

It was objected, among other things, to this patent, that it was, in part, *not new*.

Lord Ellenborough, in his charge to the jury, expressed himself, upon that point, as follows:—"In inventions of this sort, and every other, through the medium of mechanism, there are some materials which are common, and cannot be supposed to be appropriated in the terms of *any* patent. There are common elementary materials to work with in machinery, but it is the adoption of these materials, to the execution of any particular purpose, that constitutes the invention; and if the *application* of them be *new; if the combination in its nature be essentially new;* if it be productive of a *new end*, and beneficial to the public, it is that species of invention, which, protected by the King's patent, ought to continue to the person, the sole right of vending it."

8. *The combination must be new, from the beginning.*

In the case of Bovill v. Moore, 2 Marshall's Reports, 211, the plaintiff claimed as assignee of a patent granted to John Browne, for a machine for manufacturing of bobbin lace. The specification described the nature of the invention, and in what manner the same was to be performed, by six plans, or drawings, thereto annexed, which represented the different parts of the machine, and different views of the whole. The merit of the invention consisted in the mode of supplying the warp, and diagonal threads, respectively. The defendant proved, that up to the point where the perpendicular threads cross each other, the operation of the machine was similar to the *old* machines, and particularly to one of Heathcote's. Chief Justice Gibbs told the jury, that if they thought Browne had invented a *perfectly new combination of parts from the beginning*, though all the parts, *separately*, might have been used before, his specification would be good.

This opinion was confirmed on a motion for a new trial, when the Chief Justice added, "that it was not immaterial to consider, that the drawing, or plans, of the machine, were divided into six different sections, and as to one of them, the witnesses said that it existed entirely in the old machine; and that a machine carried no further, would have been a very useful invention."

9. *In order to give the patent validity,* AS A COMBINATION, *it must appear that* NONE *of the parts have ever before been used,* COMBINEDLY, *in any other machine.*

This was also decided in the case last cited, for the Chief Justice added, that if the jury should be of opinion, that a combination of a certain number of these parts, had previously existed, up to a certain point, and that Browne had taken up his invention from that point only, adding other combinations to it, it was bad.

And in Barrett v. Hall, 1 Mason's Reports, 476, Judge Story lays down the rule explicitly, that where a combination of machinery already exists, up to a certain point, and the patentee makes an addition, or improvement, to the machinery, he must confine his patent to the improvement; for if he takes a patent for the whole machine, as improved, not distinguishing between the new and old, nor limiting his patent to the improvement, it is void; because, as so claimed, it is not his invention.

10. *The patentee must be careful to take his patent for the* COMPOUND, *and not for the* ARTICLES *of which it is composed.*

This is stated upon the authority of Buller, Justice, in the case of Boulten and Watt v. Bull, who says, "But then the patent must be for the specific compound, and not for all the articles, or ingredients, of which it is made."

11. *In an action brought for the breach of a patent right, the plaintiff must prove the invention to be new.*

In 1816, Borill sued Moore, and others, for an invasion of his patent for a machine for the manufacture of bobbin lace. Lord Chief Justice Gibbs charged the jury thus:—"In point of law, it is necessary that the plaintiff should prove, that this is a new, and useful invention, in order to entitle himself to the present action."

THE ARTISAN.—No. I.

Observations on Specific Gravity, by the EDITOR.

Under the head of "the Artisan," we intend to give popular illustrations of scientific subjects; selecting, in general, those which are more immediately applicable to the purposes of the artisan, and the manufacturer. These papers will be sometimes original, and at others, selected. The contributions of our correspondents, will, when suitable, be placed under this head. Some of the essays with which we have been favoured by Dr. Hare, are of this character; more particularly, that upon specific gravity, in our first number, and his "Illustrations of atmospheric pressure." To these we now add three others, ON HYDROMETERS, ON NICHOLSON'S GRAVIMETER, and ON THE BUOYANCY OF AIR. These papers are not meant as contributions to the stock of knowledge possessed by those who are habituated to the pursuits of science, but are intended to diffuse some acquaintance with its principles and processes, among practical men, to whom it may prove a valuable auxiliary, in their respective occupations.

HYDROSTATICS, *is that branch of science which explains the effects produced by non-elastic fluids,* (liquids,) *in consequence of their weight, or pressure.* It is in consequence of this pressure, that certain bodies float upon the surface of liquids; most of the different species of wood, float upon water, and most of the metals, upon quicksilver. The ascertaining of the specific gravity of different bodies, is an Hydrostatical operation.

By *Specific Gravity* is meant the weight of different kinds, or species of matter, when compared with some other kind or species as a standard: but in order to effectuate this, it is necessary to compare equal bulks of each, as their relative weights cannot otherwise be ascertained. It is altogether unimportant what these bulks are, for if a gallon of quicksilver, be fourteen times the weight of a gallon of pure water, it is evident that a gill of the metal, will also be fourteen times as heavy as a gill of water.

Water has been adopted as the standard with which other substances are compared; various reasons might be assigned for this choice, but the following will be sufficient to satisfy every one, of its peculiar adaptation to the purpose. Water can be obtained in all habitable situations; rain water is sufficiently pure, for the operation, and any kind of water may be made so, by distillation. This fluid being easily rendered pure, and sustained at a medium temperature, say 60° of Fahrenheit's Thermometer, affords an article, which at all times, and in all places, will be of the same density; that is, equal bulks, will be, precisely, equal in weight.

From the preceding remarks, it must be evident, that the specific gravity, of any body may be expressed in numbers, without regard to its absolute weight. The numbers, representing, simply, how many times heavier, or lighter than an equal bulk of water, the article is, which is under consideration, whether it be a solid, a liquid, or an air; and if in a table of specific gravities, we find gold marked 19,

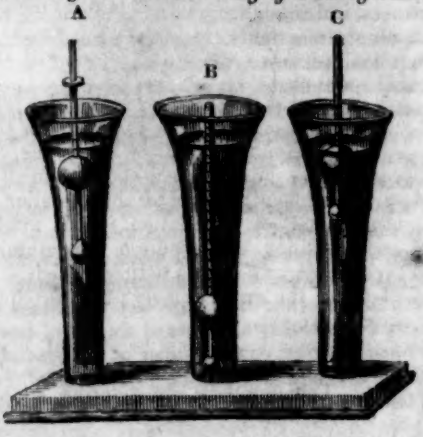
and lead 11, we know that any portion of either, will be found to be so many times heavier, than an equal bulk of water. Articles lighter than water, must, of course, be expressed in fractional parts. Should we find cork stated to be 0.25, which is equivalent to $\frac{1}{4}$, we know that another piece of cork, whatever its size, weighs one-fourth as much, as an equal bulk of water; the two portions of cork being supposed to be alike in density.

Several methods for finding the specific gravity of solids, are detailed in the paper of Professor Hare, to which we have already alluded. Those on the *Chyometer*, and *Litrameter* explain the application of those instruments, in ascertaining the specific gravity of liquids, and the first of the subjoined communications, relates, principally, to instruments ordinarily used for the same purpose. The second, exhibits the use of Nicholson's Hydrometer, or Gravimeter, in ascertaining the specific gravity of solids.

Various other Hydrometers have been constructed, and are used for different liquids, and in different countries; but it will be seen that whether known under the name of *Hydrometer*, *Essay Instrument*, *Pese-liquer*, *Areometer*, *Gravimeter*, *Alcohometer*, or *Saccharimeter*, they all operate upon the same principle, and serve as measures of the density of different liquids. They are made of different materials, and are differently graduated, so as to adapt them to particular fluids: for acids, and other corrosive liquids, glass is always used, and but for its brittleness, it would be preferable, in most cases.

This subject will be resumed in a future number, as several remarks, which we had intended to make, are omitted, in order to prevent the extension of the present article, to an unacceptable length.

Remarks on Hydrometers. *By* Robert Hare, *M. D. Professor of Chemistry in the University of Pennsylvania.*



The above is a representation of three Hydrometers, A, B, and C, contained in glass vessels. B and C are of glass, and A of metal.

B is intended for liquids heavier than water; C, for those which are lighter. In each, the graduation commences at that point of the stem, to which the instrument sinks in distilled water. It must, of course, commence at the top of the stem, for liquids heavier than water; and, at the bottom of the stem, for liquids lighter than water. In the former case, as in that of spirituous liquors, or of ether, the strength being greater, as the liquid is lighter, more of the stem is immerged, in proportion as the liquid is stronger: but, the opposite is true, in the case of acid and saline solutions, or infusions of vegetable matter; the more the stem emerges from these, the heavier, and, of course, the stronger, they are. The instruments are represented, as when swimming in pure water.

At A is an Hydrometer, of a form much used in this country and in England, both for spirit and for infusions of vegetable matter. The stem is virtually lengthened, by the use of several small weights, which may be slipped on and off at pleasure.

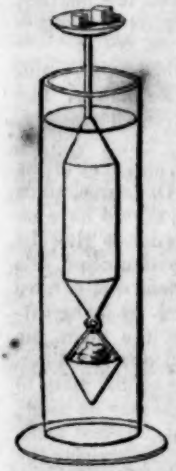
The whole difference, between the weight of water, and that of the strongest spirit, is about two parts of water in ten. Of course, since spirit is lighter than water, an Hydrometer for spirit, should have on its stem a scale of more than two hundred parts, in order to give the specific gravity of every spirituous mixture, of water with alcohol. To render such graduation sufficiently discernible, the stem would have to be of a very inconvenient length. This is obviated, by using different weights. When the heaviest weight is upon the stem, the whole of the stem stands above the surface, in distilled water. When the liquid contains enough spirit to allow the whole of the stem to sink in it, while supporting this weight, a lighter weight may be used; and, when the stem, again, would be wholly immersed, this last mentioned weight may be exchanged for one still lighter. Supposing the stem graduated into fifty parts, three weights would give fifty degrees each; and the stem, unloaded, fifty more. Were the stem graduated into ten parts, nineteen weights would give one hundred and ninety parts; and the stem, unloaded, ten more.

An instrument, sometimes called a Saccharometer, but precisely similar in principle, is used for infusions of vegetable matter, especially for the wort of brewers and distillers—excepting, that the scale begins at the top of the stem, with a line which coincides with the surface of pure water, at sixty degrees Fahrenheit, when the Hydrometer is immersed in it. When the infusion is strong enough to support the whole of the stem above its surface, a weight is to be added, heavy enough to bring the graduated part of the stem into the liquid. And, in like manner, as the infusion is found stronger, weights still heavier must be added, the process being perfectly analogous to, but, the converse of that, described in the case of alcohol. In either case, the weights must form a series, each number of which differs from that next to it, by a weight equal to that of a quantity of the liquid which it is destined to assay, equivalent in bulk to the graduated part of the stem.

As each weight is destined to assay a liquid, of a different gravity, and as the graduated part of the stem, displaces always the same

bulk, it follows, that the difference between the weights must be less, in proportion, as the liquid, for which they are intended, is lighter; and greater, as it is heavier.

On the Use of Nicholson's Gravimeter, in ascertaining the Specific Gravity of Solids, either heavier, or lighter, than water. By Robert Hare, M. D.



The accompanying cut is a representation of Nicholson's Gravimeter, the construction of which is sufficiently obvious.

On the upper scale of the instrument, whilst floating in water, place any body, the specific gravity of which is to be found—a piece of coin, for instance—and add as much weight to the same scale, as will sink the Gravimeter, until a mark, purposely made in the stem, coincides with the surface of the water. The coin is then to be transferred to the lower scale, and as much weight added to the upper one, as compensates this change. This weight is obviously just equivalent to the resistance which the coin encounters, in sinking in water. Let this weight be called A.

In the next place, the body is to be removed from the Hydrometer, and as much weight (B) again added to the upper scale, as will cause the mark upon the stem to coincide with the aqueous surface. Of the weight first employed, no account need be taken; but, the weight A, and the weight B, used in the second and third steps of the process, are to be carefully noted, and added together; the sum of A and B is then to be divided by A, the first noted number. This number A, represents the weight of a bulk of water, equal in bulk to the coin; while the sum of the numbers (A and B) is equivalent to the weight of the coin: since that aggregate weight has been found equivalent to the weight of the coin in sinking the Hydrometer.

To find the gravity of a body lighter than water, by Nicholson's Gravimeter.

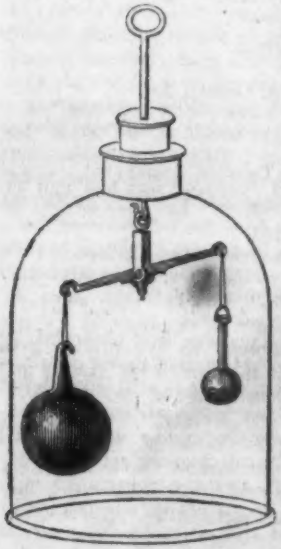
Should the gravity of a light body, as a piece of cork, for instance, be in question, place it on the upper scale of the Gravimeter, load the instrument, so as that the mark on the stem, may coincide with the surface of the water, as in the case above stated; a leaden disk being previously laid upon the lower scale. The cork being removed, the weight requisite to compensate its absence, gives the weight of the cork. This weight, being added to that which will compensate its buoyancy, when immersed in water, by being placed beneath the leaden disk in the lower scale, gives the weight of a quantity of water, equal in bulk to the cork. Hence, if the number of grains repre-

senting the weight of the cork, be divided by those representing the weight of its bulk of water, the quotient will be the specific gravity; which, in this case, must be expressed in a decimal fraction, as it is less than unity.

These operations with the Gravimeter might be much facilitated by using measures of water, made by the *Chyometer*, in lieu of weights. In that case, a small receptacle for water, must be attached to the upper scale.

On the Buoyancy of Air. *By* Robert Hare, M. D.

A pound of feathers heavier than a pound of lead.



If two bodies, one of which is more bulky than the other, be found equiponderant, in the ordinary process of weighing by a balance, the larger body is the heavier.

Let the bodies in question, be those represented within the receiver of an Air Pump, in the subjoined figure. On withdrawing the air, by means of the pump, it will be found, that the larger body preponderates, though previously counterpoised with accuracy.

Rationale.

It has been shown, by the preceding illustrations, that, when any body is surrounded by a fluid, it is buoyed up with a force in proportion to the weight of the fluid, and the quantity displaced by the body. Of course, the more space it occupies, in proportion to its weight, the more will its weight be counteracted. In the case of the two bodies rendered equiponderant, in air, the weight of the larger is most counteracted by the air. Hence, on exhausting the air from the receiver, the larger body shows a preponderancy over the other, equivalent to the superior support which the air had afforded it.

A similar result may be obtained, if hydrogen be substituted in the receiver for atmospheric air; because, as its specific gravity to that of the air, is, only, as 1 to 14, nearly, each body would lose $\frac{13}{14}$ of the support which the air had afforded; but, the larger body having received more, would lose more. It follows, that the common saying, that 'a pound of feathers is as heavy as a pound of lead,' is less than the truth, as they would really prove heavier, were the air removed.

I will take this opportunity of suggesting, that the comparative gravities of the gases might be ascertained, by means of two bodies,

counterpoised as in the figure; by ascertaining the rarefaction, or condensation of each gas, which would make them equiponderate in it, as if it were atmospheric air. In that case, the smaller body should be of platina, which, of all bodies, is the heaviest in proportion to its bulk; and the larger should be of glass, as thin as would be competent to sustain the requisite changes of pressure; since I know of no body, equally firm and impervious, which would be as light in proportion to its bulk. The changes of density might be effected by the air pump, or condenser, and would be discernible by means of a gage.

NATURAL HISTORY.

*The Common Opossum.**

Didelphis Virginiana; Penn. Gmel., &c.

Le Manicou: Feuille, Obs. Peru, iii. 206.
Tlaquatzin: Hernand. Mexico, 330.
Opossum: Lawson's Carolina, 120. Catesby's Carolina, App. xxix.
Sarigue des Illinois: Buff. Sup. tom. vi. pl. 33. Sarigue à long poil, Ibid. pl. 34.
Didelphis Opossum: L. Gmel. Syst. Nat. i. p. 105.
Micouré premier: D'Azzara, Quad du Paragua, Trad. Fran. i. p. 244.
Virginian Opossum: Penn. Quad ii. p. 18, No. 217, Shaw, i. part 2, pl. 107.
Didelphis Woapink: Barton, Facts and Conjectures, &c.

Centuries have elapsed, since this species was first observed by European naturalists, and it has long been a frequent theme of admiration and discussion to those of America, yet it is still considered as a sort of anomaly among animals, and the peculiarities of its sexual intercourse, gestation, and parturition, are to this day involved in profound obscurity. Perhaps nothing can more clearly demonstrate the impatience of the human mind, and the reluctance with which men yield to the hard necessity of carefully observing the operations of nature, than the history of this animal. Volumes of facts and conjectures have been written on the subject, in which the proportion of *conjecture* to *fact*, has been as a thousand to one, and the difficulties still remain to be surmounted. The animal is among the most common within our borders, and is annually killed, or captured, in large numbers; faithful investigations into the habits of a few individuals, would be sufficient to settle all doubts for ever, and yet these still remain to be made. Very full and interesting observations have been made at almost every other period; but the great question, how the helpless offspring, weighing scarcely a grain, are conveyed into the external pouch, and attached to the teat of the mother, has never been properly answered.

* From Vol. 2, of Godman's Natural History;—not yet published.

The opossum is very remarkable from other peculiarities, besides those which relate to the continuation of its kind. In the first place, we have already seen, that it has a very large number of teeth,* and its hind feet are actually rendered hands, by short, fleshy and opposable thumbs, which, together with the prominences in the palms of these posterior hands, enable the animal to take firm hold of objects which no one would think could be thus grasped. An opossum can cling by these *feet*-hands to a smooth silk handkerchief, or a silk dress, with great security, and climb up by the same. In like manner he can ascend by a skein of silk, or even a few threads. The slightest projection, or doubling, of any material, affords him a certain mean of climbing to any desired height. Another curious and amusing peculiarity, is his prehensile tail; by simply curving this at the extremity, the opossum sustains his weight, and depends from a limb of a tree, or other projecting body, and hanging in full security, gathers fruit, or seizes any prey within his reach; to regain his position on the limb, it is only necessary to make a little stronger effort with the tail, and throw his body upward at the same time.

In speaking of the more obvious peculiarities of the opossum, we may advert to the thinness and membranous character of the external ears, which may remind us in some degree of what has been heretofore said relative to the perfection of the sense of touch possessed by the bat, in consequence of the delicacy of the extended integument forming the ears and wings. The extremity of the nose of our animal is also covered by a soft, moist and delicate integument, which is, no doubt, very sensitive. On the sides of the nose, or rather on the upper lip, there are numerous long, and strong, divergent whiskers, or bristles, projecting to the distance of nearly three inches; over each eye there are two long black bristles, rather softer than the others, somewhat crisped, or undulated, and slightly decurved; while, on the posterior part of the cheek, and about an inch below and in front of the ear, there is a bunch of long, straight bristles, (very similar to those of a hog,) six or eight in number, projecting laterally, so as to form a right angle with the head. When the elongated conical form of the opossum's head is recollected, together with its nocturnal habits, we cannot avoid remarking, that all these arrangements appear to have immediate reference to the safety of the

* In speaking of the Pouched or Marsupial animals, Dr. G. has remarked, that "they are wonderfully unlike all other animals in relation to the production of their offspring, which are brought forth in a condition apparently imperfect or premature. The young, when they are first to be discovered in the external pouch, seem scarcely formed, are incapable of movement, exhibit but slight traces of limbs, or other external organs, are found attached to the teats of the mother, and are unable to resume their hold if it be broken. They remain thus attached until they acquire size and strength enough to move about at will, and continue to take refuge in this curious retreat until they attain the size of a common rat, or are even larger. The pouch is formed by a process, or elongation of the skin of the belly, and is supported by two peculiar bones, which arise from the pubis, and are sustained by the abdominal muscles." Dr. G. observes, on the dental system of the Genus, that they have 50 teeth: 26 in the upper, and 24 in the lower jaw.—[Ed.

animal, furnishing the means of directing its course, and warning it of the presence of bodies which otherwise might not be discovered until too late.

The mouth of the opossum is very wide when open, yet the animal does not drink by lapping, but by suction. The wideness of the mouth is rendered very remarkable, when the female is approached, while in company with her young. She then silently drops the lower jaw to the greatest distance it is capable of moving, retracts the angles of the lips, and shows the whole of her teeth, which thus present a formidable array. She then utters a muttering kind of snarl, but does not snap, until the hand, or other object, be brought very close. If this be a stick, or any hard or insensible body, she seldom closes her mouth on it after the first or second time, but maintains the same gaping and snarling appearance, even when it is thrust into her mouth. At the same time, the young, if they have attained any size, either exhibit their signs of defiance, take refuge in the pouch of the mother, or, clinging to various parts of her body, hide their faces amidst her long hair.

The general colour of the opossum is a whitish gray. From the top of the head along the back and upper part of the sides, the gray is darkest, and this colour is produced by the intermixture of coarse white hairs, upwards of three inches long, with a shorter, closer, and softer hair, which is white at base, and black for about half an inch at tip. The whole pelage is of a wooly softness, and the long white hairs diverging considerably, allow the black parts to be seen, so as to give the general gray colour already mentioned. On the face the wool is short, and of a smoky white colour; that on the belly is of the same character, but it is longer on the fore and hind legs; the colour is nearly black from the body to the digits, which are naked beneath. The tail is thick, and black, for upwards of three inches at base, and is covered by small hexagonal scales, having short rigid hairs interspersed throughout its length, which are but slightly perceptible at a little distance. The opossum is generally killed for the sake of its flesh and fat. Its wool is of considerable length and fineness during the winter season, and we should suppose that in manufactures it would be equal to the sheep's wool which is wrought into coarse hats.

The opossum is a nocturnal and timid animal, depending for his safety, more on cunning, than strength. His motions are slow, and his walk, when on the ground, entirely plantigrade, which gives an appearance of clumsiness to his movements. When on the branches of trees, he moves with much greater ease, and with perfect security from sudden gusts of wind; even were his weight sufficient to break the limb on which he rests, there is no danger of his falling to the earth, unless when on the lowest branch, as he can certainly catch, and securely cling, to the smallest intervening twigs, either with the hands or the extremity of the tail. This organ is always employed by the animal while on the smaller branches of trees, as if to guard against such an occurrence, and it is very useful in aiding the opossum to collect his food, by enabling him to suspend himself from a branch above, while rifling a bird's nest of its eggs, or gathering fruits.

The food of the opossum varies very much according to circumstances. It preys upon birds, various small quadrupeds, eggs, and no doubt occasionally upon insects. The poultry-yards are sometimes visited, and much havoc committed by the opossum, as, like the weazel, this animal is fonder of cutting the throats and sucking the blood of a number of individuals, than of satisfying his hunger by eating the flesh of one. Among the wild fruits, the persimmon (*Diospyros Virginiana*) is a great favourite, and it is generally after this fruit is in perfection, that the opossum is killed by the country people for the market. At that season it is very fat, and but little difference is to be perceived between this fat, and that of a young pig. The flavour of the flesh is compared to that of a roasting pig; we have in several instances seen it refused by dogs and cats, although the opossum was in fine order, and but recently killed. This may have been owing to some accidental circumstance, but it was uniformly rejected by these animals, usually not very nice when raw flesh is offered.

The hunting of the opossum is a favourite sport with the country people, who frequently go out with their dogs at night, after the autumnal frosts have begun, and the persimmon fruit is in its most delicious state. The opossum, as soon as he discovers the approach of his enemies, lies perfectly close to the branch, or places himself snugly in the angle where two limbs separate from each other. The dogs, however, soon announce the fact of his presence, by their baying, and the hunter ascending the tree, discovers the branch upon which the animal is seated, and begins to shake it with great violence to alarm, and cause him to relax his hold. This is soon effected, and the opossum attempting to escape to another limb, is pursued immediately, and the shaking is renewed with greater violence, until at length the terrified quadruped allows himself to drop to the ground, where hunters, or dogs, are prepared to despatch him.

Should the hunter, as frequently happens, be unaccompanied by dogs when the opossum falls to the ground, it does not immediately make its escape, but steals slowly and quietly to a little distance, and then gathering itself into as small a compass as possible, remains as still as if dead. Should there be any quantity of grass or underwood near the tree, this apparently simple artifice is frequently sufficient to secure the animal's escape, as it is difficult by moonlight, or in the shadow of the tree, to distinguish it, and if the hunter has not carefully observed the spot where it fell, his labour is often in vain. This circumstance, however, is generally attended to, and the opossum derives but little benefit from his instinctive artifice.

After remaining in this apparently lifeless condition, for a considerable time, or so long as any noise indicative of danger can be heard, the opossum slowly unfolds himself, and creeping as closely as possible upon the ground, would fain sneak off unperceived. Upon a shout, or outcry, in any tone, from his persecutor, he immediately renews his death-like attitude and stillness. If then approached, moved or handled, he is still seemingly dead, and might deceive any one not accustomed to his actions. This feigning, is repeated as frequently as opportunity is allowed him of attempting to escape, and

is known so well to the country folks, as to have long since passed into a proverb. "He is playing '*possum*" is applied with great readiness by them to any one who is thought to act deceitfully, or wishes to appear what he is not.

The usual haunts of the opossum are thick forests, and their dens are generally in the hollows of decayed trees, where they pass the day asleep, and sally forth, mostly after night-fall, to seek for food. They are occasionally seen out, during day-light, especially when they have young ones of considerable size, too large to be carried in the maternal pouch. The female then offers a very singular appearance, as she toils along with twelve or sixteen cubs nearly of the size of rats, each with a turn of his tail around the root of the mother's, and clinging on her back, and sides, with paws, hands, and mouth. This circumstance was thought distinctive of another species, hence called *dorsigera*, but is equally true of the common or Virginian opossum. It is exceedingly curious and interesting to see the young, when the mother is at rest, take refuge in the pouch, whence one or two of them may occasionally be seen peeping out, with an air of great comfort and satisfaction. The mother in this condition, or at any time in defence of her young, will make battle, biting with much keenness and severity, for which her long canine teeth are well suited.

If taken young, the opossum is readily tamed, and becomes very fond of human society, in a great degree relinquishes its nocturnal habits, and grows troublesome from its familiarity. We have had one thus tamed, which would follow the inmates of the house with great assiduity, and complain by a whining noise, when left alone. As it grew older it became mischievous from its restless curiosity, and there seemed to be no possibility of devising any contrivance effectually to secure it. The same circumstance is frequently remarked by persons who have attempted to detain them in captivity, and of all the instances which have come to our knowledge, where even a great number were apparently well secured, they have all in a short time enlarged themselves, and been no more heard of. In some such instances these animals have escaped in the city, and for a long time have taken up their quarters in cellars, where their presence has never been suspected, as during the day they remain concealed. In this way it is very probable that many are still living in the city of Philadelphia, obtaining a plentiful food by their nightly labours.

In Dr. Barton's 'facts and conjectures' on the opossum, he mentions as a circumstance worthy of curiosity, the faculty the opossum has of lying on its back. We have observed this action of the animal, but could see nothing in it very different from what is very frequently done by the dog, cat, marmot, squirrel, and various other animals, which occasionally place themselves sufficiently on the back to expose the inferior surface of the body, fully; but that this action in the opossum is indicative of any peculiarity, or is the ordinary position chosen by the animal, is what we cannot state from our own observation.

The length of the full grown opossum is about twenty inches, and that of the tail, twelve; the weight is about fourteen pounds. The number of young is from twelve to sixteen. There is therefore not

much probability of the species becoming very scarce, especially as their nocturnal mode of life, renders it by no means necessary that they should fly to very remote distances from the habitations of man.*

FROM THE QUARTERLY REVIEW.

Proposed Expedition to the North Pole. By Captains PARRY *and* FRANKLIN, *jointly.*

It was not to be expected that a man of Parry's activity of mind, and who had so long been engaged in the pursuit of discovery, would be content to remain quietly on shore. He knew that a project had been entertained, by another able and indefatigable officer, of proceeding from Spitzbergen to the North Pole, and he knew that such a man as Franklin, was not likely to suggest and adopt a measure that was not likely to carry with it a chance of success. When two such men as Parry and Franklin, after weighing well the risk to be encountered, and all the circumstances which make for, and against, an undertaking of this nature, offer a plan, for the execution of which they propose to embark themselves, it would surely be something like presumption to affect to undervalue their experience, or to pronounce *their* scheme rash and chimerical.

The President and Council of the Royal Society were clearly of this opinion. In a letter to Lord Melville, they signified their approbation of Captain Parry's proposal, and their opinion that such an enterprise cannot fail to afford many valuable scientific results, and to settle matters of philosophical inquiry; and they concluded by expressing their wishes, that this proposition of so brave, enlightened, and scientific an officer, might meet with the attention it appeared to them to deserve, from the Admiralty.

The Board of Admiralty will scarcely be accused of inattention to any recommendation of this learned body, or of any backwardness in lending its aid toward such undertakings as may have for their object the promotion of science, or the acquirement and extension of useful knowledge. Accordingly, on this recommendation of the proposal of Captain Parry, the Hecla has been ordered to be prepared for the

* It is amusing to read the accounts of the wonderful medical virtues which have been attributed to the tail of this animal, in some of the older writers on the natural history of our continent. The following is a good specimen of the credulity and disposition to deal in the marvellous, which was formerly thought to form an almost essential quality in the natural historian.—"The tail of this animal (says MARCGRAVE) is a singular and wonderful remedy against inflammation of the kidneys; for if it be broken, and the quantity of a drachm of the water in which it is steeped be drunk sometimes, fasting, it wonderfully cleanses the ureters, expels calculi and other obstructions, [excitat venerem, et generat lac, medetur colicis doloribus, prodest parientibus et accelerat partum, promovet menses,] and if it be chewed and placed on a part into which thorns have been thrust, it extracts them, loosens the bowels, and I believe in all New Spain there is not to be found another remedy as useful in so many cases."—*Hist. Ker. Nat. Brasil, lib. vi. p.* 22.

service in question, and to be ready in the early part of next spring. The plan is, as we understand, to proceed in the Hecla to that part of Spitzbergen, called 'Cloven Cliff,' in latitude 79° 52′, so as to reach it towards the end of May. Its distance from the Pole is about 600 miles. This distance is to be performed by means of two boats, so constructed as to be light, tough, and rather flexible; to be furnished with *runners*, in the manner of sledges; and to be covered with leather, like the Russian *baidars*, in which long voyages are performed; to have besides, a covering, or awning, of oil skin, convertible into a sail. Each boat is to be manned with two officers and ten men; and to carry provisions for ninety-two days, which, at the moderate rate of thirteen miles a day, will be sufficient for the performance of the journey to the Pole, and back again to Spitzbergen.

The boats are furnished with runners, in the uncertainty of the intermediate space being ice or water; the probability is, that it will be found to consist of both; in which case, the boats will sail in the water, and be dragged over the ice. Captain Parry proposes to take from Spitzbergen a few dogs, or rein deer, to assist in dragging the boats; both animals will feed on fish, which may perhaps be easily caught; and if their provisions fail, they may become food for the use of the party.

"The practicability," says Captain Parry, "of thus reaching the North Pole, appears to me to turn wholly on the question of resources. This being the case, it would very soon become a matter of scientific calculation, whether or not the object was within the reach of the resources with which the party was furnished; so that they might at any time proceed or return, according to circumstances. In other respects I can perceive nothing whatever that should make it an enterprise of extraordinary risk. The summer temperature of the Polar regions is by no means uncomfortable: the sun would be constantly above the horizon; and our men have always enjoyed remarkably robust health during excursions of this nature. If open water should frequently occur, it is *always sure to be smooth*, and even if it were otherwise, a boat hauled up on a floe of ice, is as sure as on the shore. In fact, the more open water is found, the more easy would be the accomplishment of the enterprise; and taking the chance of such occasional assistance, I cannot but entertain a confident hope, that the whole might be completed by the end of August, and the expedition arrive again in England before the middle of October."

During the three months absence of the Polar party, it is intended to make the boats of the Hecla subservient to the interests of science, by sending out a qualified surveyor, to explore and survey the eastern coast of Spitzbergen, of which, not without shame be it spoken, we are at present wholly ignorant. The party left with the ship might also be most usefully employed in conducting a series of experiments on the pendulum, in making a variety of interesting magnetic observations, in attending to the various meteorological phenomena, and in collecting specimens of natural history. It will also be an object of importance, to ascertain whether new whale fishing stations, may not be discovered on the eastern side of Spitzbergen, to

supply the place of those nearly worn out ones, on the western side, from which the whales have either been driven away, or destroyed by the long and constant visits of ships employed in the fishery—just as the Davis' Strait fishery was worn out on the eastern side, and was annually declining, till Parry led the way to the western shore of that Strait, whither the fishing ships now constantly resort, and whence they generally return with full cargoes.

When we call to mind the enterprising expedition of the Baron Wrangel, who was forty days on the ice of the Polar Sea, with sledges not convertible into boats, we confess that Parry's projected journey appears to us divested of any very great danger; doubly provided, as he is to be, he will not be exposed at any rate, to the risk which the Baron experienced, when cast adrift on a pack of ice, and driven about at the mercy of the wind, which fortunately blew him at last *only* to the coast of Siberia.

We verily believe, that on the Pole itself, neither wind nor tide, rain nor snow, thunder nor lightning, will be found to exist; or, if any of them exist at all, it will be found in the smallest possible degree.

Manufactories in Massachusetts.

Merrimack Manufacturing Company, has a capital of $1,200,000, (the whole of which has been paid in,) and was incorporated in 1821. It is situated in the eastern part of Chelmsford, in Middlesex county, near Patucket Falls, and on the canal constructed in 1793, by the proprietors of the Middlesex canal, the first in the United States. The fall of the Merrimack, at Patucket, is thirty feet. The distance north-west from Boston, is twenty-two miles, and from Salem, about the same distance. To the flourishing village of Haverhill, on Merrimack, and nearer to the sea, it is twelve miles.

Five mills have already been erected, containing 4000 spindles each; and three, furnished with proper machinery, are also in operation. Another, with machinery, will be ready the first of January next. About 200 men, and 180 females, are employed in each mill. None are under the age of twelve, and very few are so young. The wages of these persons depend, in some measure, upon their skill and industry. Some earn $2 a week, and others only 1, besides board, which is $1 25. The men receive more. In each mill, 2500 yards are woven daily, of No. 22, 30, and 40 yarn, respectively. All this is bleached; and about three-fourths of it is printed.—Those exhibited in Boston, at the great fair lately, were very fine, and fully equal to those from Taunton, in the opinion of all who examined them.

In the print and bleach work, 50 men and 30 women are employed. The whole work is carried on in the yard, from preparing the colours to the engraving of the cylinders.

An extensive woolen manufactory was established at this place before 1821, and has lately increased in business.

Since the Merrimack Manufacturing Company commenced build-

ing, there have been built, in this part of Chelmsford, (now Lowell,) two hundred dwelling-houses, and the village is rapidly increasing.

It may be proper to observe, that in 1823, the proprietors of the Locks and Canals, on Merrimack river, having increased their stock in the sum of $600,000, purchased of the Merrimack Manufacturing Company, all their spare land, and the residue of the water power the latter had created, and also a large machine shop, where machinery for two mills is completed annually. In these, 200 first rate mechanics in iron, wood, &c. are constantly employed. More than a ton of castings is required daily, and furnished by a furnace within four miles. A company, called the Hamilton Manufacturing Company, has recently erected two mills, on land purchased of the proprietors of the Canal and Locks, one of which is in operation. They also have a capital of $600,000; and their buildings are of brick.

The water power of Lowell is great and abundant, and its quality is excellent for bleaching and dying.

The Merrimack is navigable for upwards of a hundred miles above Lowell, and furnishes abundant supplies of wood, lumber, and brick. The communication with Boston is greatly facilitated by the Middlesex canal, by means of which, all heavy articles are transported at a comparatively low rate. The canal packet boat runs three times a week; and a stage goes out, and in, every day, to, and from Boston; besides others to Worcester, Newburyport, Dover, and Concord, N. H. &c. A bridge is also now building over the Merrimack, near the junction with Concord river.

Shepherd Woolen Factory, at Northampton, on Connecticut river. The capital, $130,000—persons employed, 112.—37,500 yards of superfine and second quality of broadcloths manufactured, annually; and in this, 75,000 lbs. of Saxon and American wool, of first quality, are used.

In another factory, belonging to Messrs. Cooks, in Northampton, 10,000 yards have been made in ten months; being about 40 yards a day—for this, about 25,000 pounds of raw wool are worked annually. Much of the work is done by machinery. One jenney in Cook's factory has 100 spindles—three others, 80 each—and a billy with 50 spindles. The capital of this factory we do not know.

[*Boston Commercial Gazette.*

Steam power employed in Great Britain.

The subjoined calculations are from a late number of the *Quarterly Review*; as it serves to give a sensible form, to the estimate of the immense effective power, created by substituting a few hogsheads of water, for a few millions of men, we prefer it to the mere expression of horse power, or of pounds weight, which convey a very inadequate idea to the mind, even in those who are familiar with numbers.

"All the world is more or less acquainted with those immense masses, the pyramids of Egypt, which were considered among the

wonders of antiquity. The materials of which the largest of them is constructed, were dug out of the earth at a considerable depth; and at no small distance from their present situation. They cover more than eleven English acres, and are piled up to the height of about 700 feet. According to M. Dupin's calculation, their volume is equal to about 4,000,000 of cubic metres; their weight is 10,400,000 tons; which raised to the height of eleven metres from the bottom of the quarries to the surface of the earth, and of forty-nine more, as their mean elevation above the basis; in all 60 metres above their original level, give 624,000,000 tons raised to the height of one metre.* Now the steam-engines employed in England are equal to the force of 320,000 horses (1820,) and can raise 862,800,000 tons to the height of one metre, in twenty-four hours. But 624,000,000 being less than three-fourths of this quantity, it follows that the steam-engines of England could have raised the materials of which the great pyramid is constructed out of the quarries, could have conveyed them to their present place, and heaped them up in their present form, in less than three-fourths of one day, that is to say, in less than eighteen hours. According to Diodorus Siculus, this building employed 360,000 workmen, according to Herodotus, 100,000 workmen, during twenty years. Whichsoever of these estimates be nearest the truth, it is certain that one of the most powerful monarchies of remote antiquity applied its whole disposable resources in the construction. Therefore the mechanical power of British steam-engines was, in 1820—and it has much increased since that time—to that of the Egyptian monarch Cheops, inversely as the times necessary to each, to perform the same task; that is to say, as twenty years to eighteen hours, or about 10,000 times as great. Neither would it be unfair to deduce from this single fact, that the general power of the two monarchies, including that which is the source of power, knowledge, was, if not exactly in this ratio, at least in a proportion which could not widely differ from it—let us, with great moderation, say one-fourth as great; that is, it is more than probable that the power of England is, at this moment, 2500 times as great as was that of Egypt, at the period when this pyramid was constructed. When we consider the reach of intellect which is necessary to devise the steam engine, in its present state, together with its general influence upon civilization, and the part it acts in national prosperity, it would be impossible for a nation which it has made many times as powerful as another by its direct effect, to be less than one-fourth as great in every branch where its action is only indirect.

"By the power of steam, every machine to which it is applied, receives, not an addition, but a multiplication of force. The power thus produced in 1820 was computed to be equal to 320,000 horses, or about 2,240,000 men. At this moment, steam, on account of its many new applications, and the improvements made in the manner of employing it, may perform the work of near three millions of men in the United Kingdom."

* The French metre is equal to about 39¼ English inches.

Remarks on the Slide rest, by the EDITOR.

The common rest, is a necessary appendage to every turning lathe, and answers perfectly well, in ordinary turning; but where surfaces perfectly flat, rollers perfectly cylindrical, or cones accurately finished, are wanted, it is not merely difficult, but absolutely impossible, to make them so, by hand. To attain these, and many other important ends, the slide-rest has been contrived, and has been long known to those who are acquainted with the manufacture of machinery and the processes in the finer kinds of work. There are still however, many ingenious mechanics, particularly in parts of the country which are distant from the larger towns or manufacturing establishments, who have no knowledge of this, and of many other modes of facilitating the nicer mechanical operations; and it is on this account that we have determined to make a few observations, as a preface to the description of the slide-rest of Mason and Baldwin. For turning rollers for flatting-mills, for cotton spinning machinery, and in fine, wherever true cylinders are wanted, a strong, straight bar, is employed, and along this, a slider is made to traverse, by means of a screw; in this slider, tools of various kinds may be firmly fixed, and carried along at pleasure. By a contrivance of this sort, *hardened steel rollers* are frequently turned, and many other similar operations performed, which would defy both strength and skill, applied in the usual way. By removing this sliding bar, to different distances, and also by shifting the tool, the diameter of the cylinder is easily regulated. Lathes are made for this purpose, which are not adapted to other uses, but the "American slide-rest," which we formerly described, and that which is now represented, are used on lathes of the common construction. Several others may be seen described in Dictionaries of arts and sciences, and in several European works, on mechanics in general, and in some, written expressly on the art of turning. Excellent instruments of this kind, are made by Maudesley, by Holtzapfel and Dyerlein, and by others in England. In the French, and other rose-work engines, they are indispensable, and have long been employed. Ornamental work, very similar to that upon many watch cases, can be performed in the common lathe, by means of an eccentric, or cycloidal chuck; but in this case, a slide-rest must be used. These instruments will hereafter be described, and figured, in this Journal, together with specimens of the work, performed by them.

Before dismissing this subject, we will remark, that in consequence of the firmness with which the tool is held, in the slide rest, and the accuracy with which it may be *fed*, and moved, there is no difficulty in turning articles which have projecting angles; a square bar, for example, may be rendered cylindrical, without the slightest danger of the tool *catching*. It is also applicable to the turning of screws of the most perfect accuracy, with but little skill on the part of the operator.

FOR THE FRANKLIN JOURNAL.

A DESCRIPTION OF

MASON AND BALDWIN'S IMPROVED SLIDE-REST.

(With a Plate.)

Fig. 1. Letter A. An iron Bracket, having a groove on the under side, to receive the head of a Screw-bolt. On the upper side is a small cylindrical projection, the top of which is a plane surface, forming a bed for the Base B, which is permitted to move round a centre bolt, and secured in any position, by the Nut C.

D. A Frame, (connected with the Base B, by the supports E E,) made perfectly flat on its upper surface, on which are secured two guides, F F, forming two acute angled channels, by which the main slide G, is retained in its place.

G. Main Slide, having two projecting tongues, fitted to, and sliding in, the above mentioned channels; whilst the flat portion of it rests upon the upper part of the Frame D.

Between the Guides F F, and extending in a parallel direction, is placed the Main Screw H, Fig. 2, passing through a semicircular Nut R, attached to the under side of the Main Slide, and supported by Bearings at each end, secured to the Frame D.

I. A detached piece of metal, set in between the tongue and the oblique side of the Guide, and adjusted to it by two small screws passing through the Tongue.

K. A semicylindrical covering, fastened to one of the guides, to protect the Main Screw H from injury by the chips or turnings. On the upper side of the Main Slide G, is a dove-tail groove, to receive the Cross Slide L.

M. Fig. 2. A Screw, by which the Cross Slide is moved; it passes through the Collar N, and works in a Nut Q, Fig. 2, fastened to the Main Slide, as in Figures 2 and 3.

P P P. Screws, by which the turning tool is secured to the Cross Slide L.

R. Set Screws, inserted in the Main Slide G, to adjust the Cross Slide L, (to which the tool is secured,) to any depth of cutting.

It is manifest, from this arrangement of the Main Screw, (which is completely protected from injury by chips or turnings, by the covering above described,) that the power is applied to the greatest advantage on the Main Slide, being in the centre of its guides; whilst the front, or that part of the Main Slide, where the tool acts, is better supported by resting on the Frame, than when overhanging, as in the Slide-rests in common use.

AN IMPROVED MILL-SPINDLE.

To the Editor of the Franklin Journal:

Sir—The gratification and benefit derived from your Journal, by mechanics, and their pioneers, the inventors, should, methinks, prompt them to communicate, in their turn, such improvements as fall within their observation.

In compliance with this suggestion, I subjoin a sketch and description, of a Spindle, for flour and corn mills, which, in some respects, will, I presume, be considered *improved.*

The drawing annexed is a Vertical Section, by which it will be seen that the outline is similar to mill-spindles in common use; but the body is larger, being usually of cast iron, about three and a half inches in diameter, and either round or octagonal, &c.; it is hollow, like a pipe, up to the Collar, by which distribution of metal, greater strength and stiffness are acquired, than if solid, and of equal weight. At the bottom, the bore is tapered upward several inches, which forms a socket for inserting a toe, which, if of wrought-iron, should be steeled at the point; a wrought and steeled Cockhead is also inserted at the top, in a square socket; or it may be tapped and screwed in. Both these points should be secured, by a screw, or pin, at the side, and a band should be driven on the lower end of the casting, to prevent splitting.

At the Collar, a small shoulder is formed, leaving the neck rather smaller than the body of the Spindle, but solid, or nearly so, in order to maintain the requisite strength. The Collar is made of any suitable metal, either cast or wrought, (I prefer the composition used in machinery, for inks,) with the bore large enough to go on the neck quite loose, and is then secured by filling the interstice with lead, or any soft metal; it may also be pinned.

The advantages of this Spindle, I conceive to consist in its greater strength and stiffness, as before mentioned, and that the wearing parts, while made of the most durable metals, are more readily repaired, or replaced. The cost of making, or repairing, will be less than that of a solid wrought-iron Spindle, of equal workmanship.

An objection common to this, with all cast-iron Spindles, will probably be made, viz. that a cast shaft, or spindle, although sustaining equal stress of torsion, with wrought-iron, of the same shape and dimensions, will yet be liable, from a sudden shock, to break and be useless; while the wrought-iron, in the same circumstances, would but twist, and so as to admit of repairing. To obviate this objection, I have introduced a cast-iron driver, of the usual form, and of such thickness as to bear rather less stress than the Spindle, that, in case of accident, (which very rarely occurs,) the driver shall break, and thus operate as a safety-guard to preserve the Spindle, and the other machinery.

I am informed, that, in Great Britain, it has been quite a desideratum, to prevent or reduce, the expansion of Spindles, which occurs from heat, generated by friction.

I do not know that this object has been attained, and would suggest, that it may probably be effected in the following

MASON & BALDWIN'S IMPROVED SLIDE REST. *Franklin Journal Vol. 2*

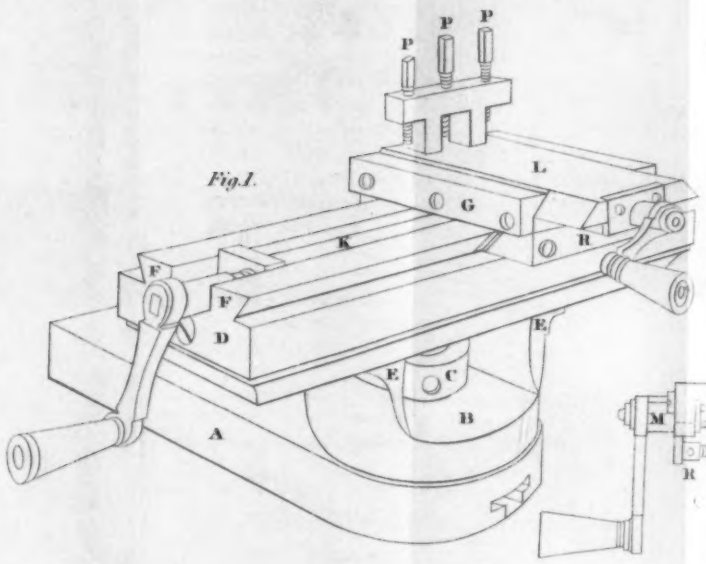


Fig. 1.

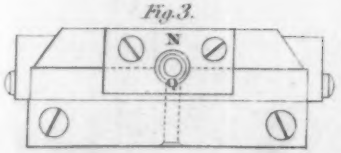


Fig. 3.

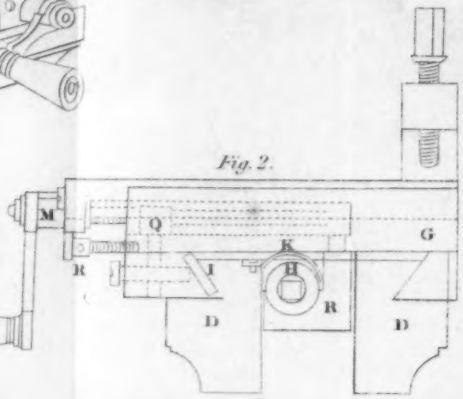


Fig. 2.

Geo. Strickland Del.

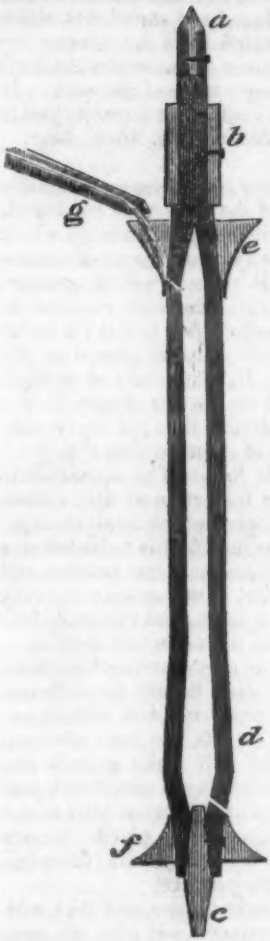
A very excellent work has been published in Paris, entitled, "*Recherches Experimentales sur les Chaux de Construction, les Bétons et les Mortiers Ordinaires.*" By L. J. Vicat.

This work, containing many important facts relating to calcareous cements, and hydraulic and common mortars, is the fruit of an immense number of experiments, the results of which are arranged in

AN IMPROVED MILL-SPINDLE.

thickness as to bear rather less stress than the Spindle, that, in case of accident, (which very rarely occurs,) the driver shall break, and thus operate as a safety-guard to preserve the Spindle, and the other machinery.

I am informed, that, in Great Britain, it has been quite a desideratum, to prevent or reduce, the expansion of Spindles, which occurs from heat, generated by friction.



I do not know that this object has been attained, and would suggest, that it may probably be effected in the following manner:

Let a funnel-shaped Rim be attached to the Spindle, just below the Collar, into which water may be conducted by a spout, and thence introduced, by a hole or holes, made in the Spindle, to its interior; the centrifugal force will probably spread the water over the interior surface, and the exterior surface may also be kept wet, if needful, by allowing water to pass between the Rim and the Spindle. The water may be thrown off the Spindle, by holes near the Toe, conducting it over an inverted Rim, fixed there. The effect of a constant stream of cold water, thus applied, must be to prevent expansion, or to render it nearly insensible.

BELIDOR.

a—the Cockhead.

b—the Collar.

c—the Toe.

d—a Square, or Cone, to receive a stone-pinion.

e—a funnel-shaped Rim, to receive water from the Spout *g*.

f—a similar Rim, inverted, to throw off the water.

Vicat on Cements.

A very excellent work has been published in Paris, entitled, "*Recherches Experimentales sur les Chaux de Construction, les Bétons et les Mortiers Ordinaires.*" By L. J. Vicat.

This work, containing many important facts relating to calcareous cements, and hydraulic and common mortars, is the fruit of an immense number of experiments, the results of which are arranged in

25 tables. These are preceded by a series of remarks and details, in which the general laws and effects are deduced and stated, but which lose the greater part of their value if separated from the tabular results. The following translations contain some of the results obtained by M. Vicat, and will give an idea of the importance of the work. It is only, however, by referring to the work itself, that a true estimate of its value can be obtained. [*Editor Lon. Mech. Mag.*

"*Trial of Lime-stones.*—It is of the utmost consequence, especially in public works, to ascertain the quality of the lime to be employed, and yet chemical analysis requires practice and knowledge which every architect does not possess. It is always more easy and certain to submit a fragment of the stone, which is to be tried, to common calcination in a lime-kiln, or, as we frequently do, with charcoal in a forge, (for coal forms clusters with the stone) than to slake it in the common way, and make a paste of it, which is to be placed at the bottom of a vessel filled with pure water. If, at the end of eight or ten days, this paste has become hard, and resists the finger, it is a proof that the stone tried, will furnish hydraulic lime; if, on the contrary, it remains soft, it has the character of common lime." p. 5.

"*To convert common lime into hydraulic lime.*—The operation to be described is a true synthesis, which, by the action of fire, unites, in an intimate manner, the essential principles which analysis separates from hydraulic lime. The lime to be modified is to be left in a dry and covered place, until reduced spontaneously into powder, and afterwards mixed by the aid of a little water, with a certain quantity of gray or brown clay, or simply with brick-earth, and this made into balls, which, when dry, are to be heated to the necessary degree.

"Common lime will require 20 per cent of clay; intermediate limestone will require 15 per cent; and 10, or even 6, will be sufficient for those which already possess hydraulic properties to a certain extent. When the quantity is raised to 33 or 40, the lime obtained will not slake, but is easily pulverized, and will make a paste that hardens very readily under water. When the clay is mixed with pebbles, &c. it is to be thrown into a large quantity of water, well mixed with it, and the finer part run off, into a convenient place. It may then be mixed with the lime in powder, and made into balls; the quantity required is easily ascertained by a little practice.

"It must not be supposed that the clay baked alone, and then added to common lime, in the proportions mentioned, will give the same results as when the two substances are mixed before being heated. The fire modifies the one substance by the other, and gives rise to a new compound, which enjoys new properties." p. 7.

"If fragments of common lime and a mixture of coal and charcoal be placed, stratum super stratum, in a small brick furnace and burnt; and if, as the substances fall by the dissipation of the combustible, the lime which passes through with the cinders, be returned with fresh fuel to the furnace, and the process be continued from 15 to 20 hours, according to the size of the fragments, an over-calcined lime will be obtained, which will not slake, but which, when reduced into a fine

powder, and made into a ductile paste, has the property of hardening under water." p. 15.

On Slaking.—Quick-lime thrown into a proper quantity of water, splits with noise, produces a bubbling, liberates hot and slightly caustic vapours, and at last forms a thick paste. If a sufficient quantity of water has not been added in the first instance, to the lime, it is necessary to wait till it is cold before more be given. If a second portion be poured on whilst the lime is hot from the effect of the first insufficient quantity, then the lime does not divide well, but remains granular. This process is called *ordinary slaking*, or the first process.

"Quick-lime plunged into water for a few seconds, and withdrawn before it begins to split, then hisses, splits, and bursts apart with noise, and falls into powder. This powder, when cold, does not heat by the addition of more water. One part of lime, thus slaked, expands into 1·5 or 1·7 parts, by measure. This is called *slaking by immersion*, or the second process."

"If quick-lime be exposed to the air, it falls to powder, one part increasing in volume to 1·75, or even to 2·55. This is called *spontaneous slaking*, or the third process." p. 16.

"*Hydrates of Lime.*—Lime slaked in these three ways, was made into masses with water; these were dried in the sun, and then their resistance or tenacity, and their hardness, ascertained; and the result was, that for all kinds of lime, the resistance and the hardness were in proportion to the expansion in bulk by the process of slaking, that is, the process which divided the lime most completely, gave a hydrate of the greatest strength." p. 25.

"*Effects of Slaking on the Hydraulic Mortars.*—It appears, from experiments on the hydraulic mortars made from common lime, intermediate or meagre lime, and lime slightly hydraulic, that the three modes of slaking, arranged according to the order of their superiority, are the third, the second, and the first; but that for hydraulic lime, the order becomes reversed. If common lime be considered as the commencement of the scale, and we pass from that, through the various shades of difference, to the hydraulic lime, which is most meagre, and which will form the last degree on the scale, the differences resulting from the methods of slaking, diminish, at last disappear, and then increase in the opposite direction." p. 42.

"*Action of Water on Hydraulic Mortars.*—The dissolving action of water on hydraulic mortars appears to cease when it has removed the excess of lime that was either in weak combination, or entirely at liberty; and, it was found that the quantity which remained after the action ceased, was never far from that which had been ascertained to be the best; from whence the following: To find in all possible cases the proportion of lime which is most fit for any puzzolana, a ball of the hydraulic mortar, nearly an inch in diameter, must be made, having rather an excess of lime; this must be exposed for a year under pure water, which is to be changed frequently, and then the quantity of lime which has disappeared, is to be ascertained either by analysis or otherwise, and subtracted from the whole quantity, and the dif-

ference gives the proportion required for the quantity of puzzolana taken." p. 55.

"*Effect of Lime on Hydraulic Mortars.*—1st. Excess of lime in an hydraulic mortar retains its setting: the proportions most favourable to the setting, are also those which give the greatest strength.

"2nd. Powerful puzzolanas, combined with common lime, harden much sooner than if combined with hydraulic lime; but hydraulic lime has the advantage when combined with a less active puzzolana.

"3d. The second and third process of slaking, appear generally to accelerate the setting more than the first.

"4. Hydraulic mortars made with common lime, harden more, or make more progress from the second to the third year, than from the first to the second, so that it may be said, the rapidity of their progress may be accelerated.

"5th. The resistance of hydraulic mortars, made with lime slightly hydraulic, also undergoes an acceleration, but much less than in the former case.

"6th. The progress of mortars, made with lime eminently hydraulic, begins to diminish at the end of the second year.

"Hence hydraulic mortars, made with common lime, require more time than the others, to attain their maximum of resistance." p. 58.

"*On the nature of Hydraulic Lime.*—The modification which the action of fire has caused in the small proportion of silex and alumine, mixed with the pure calcareous matter, gives to the compound which results, the power of acting chemically by the intervention of water on the new siliceous substances added in the state of sand. It is this circumstance which constitutes the distinctive and essential character of hydraulic lime." p. 73.

"*On the use of Siliceous Sand.*—According to our results, the different sands arrange in the following order of superiority.

"For highly hydraulic lime: 1st, Fine sand; 2nd, sand of unequal size resulting from the mixture of fine sand, either with coarse sand or small gravel; 3d, coarse sand.

"For lime moderately hydraulic; 1st, mixed sand; 2nd, fine sand; 3d, coarse sand.

"For common lime: 1st, coarse sand; 2nd, mixed sand; 3d, fine sand." p. 74.

"*Rapidity of Desiccation.*—Mortars made from hydraulic lime, which have the power of solidifying all the water they contain, require to be dried slowly. They lose, according to circumstances, viz.—By common desiccation, three-tenths, and by rapid desiccation, eight-tenths of the force which they would acquire by slow desiccation." p. 77.

On Alloys of Cast-Iron with Lead, Tin, and Regulus of Antimony.

BY THOMAS GILL, ESQ.

Several years since, the Editor was consulted, by a type-founder, respecting the nature of a metallic alloy, which had lain neglected in

his foundry for a long time, until, one day, being short of regulus, he was forced to endeavour to employ it to make type metal; he accordingly began to add lead to it, in the usual manner, but found it still unfit for use; necessity, however, compelled him to persevere, and he accordingly continued to add more and more lead to it, until it became nearer alike to type metal; *but it was not until he had employed twelve times the usual quantity of lead, that it became fit for use, and proved to be the best type-metal he had ever made!* This astonishing result led him to make the above inquiry; as, he said, the knowledge of the compound would have enabled him to make his fortune; the regulus being the most expensive article used in the type-metal. The Editor shortly afterwards mentioned this circumstance to the late celebrated Dr. Tilloch, the Editor of the "Philosophical Magazine," who said it brought to his recollection a fact that occurred to him many years ago, when he carried on the business of a stereotype founder at Glasgow. Having occasion to make type-metal, he put the lead and regulus of antimony into a cast-iron saucepan, and placed it over the fire, in a German stove, to gradually melt and unite the two metals, on his going to bed. *Next morning, on proceeding to take out his type-metal, he brought away nothing but the wrought-iron handle of the saucepan, and a ring of cast-iron affixed to it; the whole of the remainder of the saucepan, and its contents, having made their way through the fuel, and collected in the ashes under the grate. He did not, however, make any experiments with the alloy of cast-iron, regulus of antimony, and lead, thus accidentally formed.*

It has lately come to the Editor's knowledge, that, in a recent experiment, a mixture of lead and tin being repeatedly heated in a large cast-iron vessel, has at length made its way through the vessel, it remaining in the form of long masses, like icicles, adhering to the vessel. Now this circumstance throws great light upon the two former instances of the union of cast-iron with lead, under similar circumstances, although no tin was then present in the mixture; and it clearly appears to the Editor, *that the valuable mass of alloy first mentioned in this article, must have arisen from an accidental overheating of the cast-iron vessel, in which the type-metal was melted, as usual, in the foundries, and the iron thus entered into union with the lead and regulus of antimony;* and it may, therefore, well deserve a trial to endeavour to form such alloys, as substitutes for the regulus ordinarily employed in type founding.

It has also come to the Editor's knowledge, that frequently in lead works, the large cast-iron vessels employed to melt the lead in, have speedily become perforated by the lead, and rendered useless; nay, that it has become necessary, in order to prevent them from being overheated, to introduce a course of fire-bricks immediately under the bottoms of the vessels, and thus to prevent the direct action of the flame of the fire upon them; and this has been found to have the desired effect of rendering those expensive vessels more durable.

[*Technical Repository.*

Description of the chafingdish, or heater, employed for heating walls, or ceilings, which are to be saturated with a composition of oil and wax, or of oil and rosin, by the EDITOR.

In the *Journal des Connaissance usuelles*, for September, there is a plate and description of the heater employed when walls, &c. are to be saturated with the composition used upon stone and plaister, according to the process given in our last number. The construction of this heater, may be readily understood without an engraving. It may be made of sheet iron, and of any convenient dimensions; the form is that of a square box, which we will suppose to be 3 feet long, 2 feet high, and 6 inches deep, as this would probably be a good size for large surfaces. The bottom would, in this case, be 3 feet long, by 6 inches wide; the ends 2 feet by 6 inches, and the back 3 feet by 2 feet. The front consists of bars, made of large wire, and running across, like those of a common grate. There is a lid, or top, which is made to open, for the purpose of admitting the fuel. Near the bottom there is a grate for the fuel to rest upon, and under this, a space to receive the ashes. The top is made to fasten down, and to the centre of the back, is fixed a handle, by which the heater may be supported, so as to present its front vertically, against a wall, or horizontally, under a ceiling. Charcoal will be found to be the most appropriate fuel, both on account of its lightness, and its freedom from smoke. It will be best to light the charcoal before putting it into the heater.

In order to protect the hands from the heat in removing the heater from place to place, a large disc of any substance which is a bad conductor, may be fixed upon the handle, at the distance of three or four inches from the back of the instrument.

NOTICE TO EDITORS.

In availing himself of the labours of others, the Editor of this Journal has been anxious to give credit wherever it was due. In copying from Journals in which this rule is not observed, he has sometimes been unable to discover the original source of information, or it would always have been carefully noticed by him; whatever mistakes may have arisen from this cause, have been unavoidable. Some of the editors of Newspapers, are, either from wilfulness, or from want of care, guilty of injustice in this particular; nor are our foreign coadjutors exempt from the same fault. In the London *Mechanics' Magazine*, Dr. Hare's paper on specific gravity, has appeared without any indication of the article having been copied from this Journal. Credit has in another instance been given to '*Franklin's American Journal.*' We are aware that such omissions and mistakes result from inadvertence, and that nothing further is necessary, than to call attention to the subject.

INDEX.

PAGE.

Air furnace, improved, *patent*, 298
———— observations on 300
— Buoyancy of, Hare on 357
Alabaster, on Etching and Cleaning, 58
Alloys of Metals, *patent*, 215
———— Cast-Iron, Antimony, &c. 374
Alsop, on Silks and Cottons, 81
American Slide-rest, 104
———— Patents, list of 63, 128, 253, 319
Ancient Vases, 111, 220, 315, 333
Anthracite, remarks on 292
Antiquity of steam vessels, 308
Anstey's melting pots, 159
Arnot on fire places, 226
Atmospheric pressure, Hare on 148
Auger for boring square holes, 240

Backwell on band and spur wheels, 7
Bagnold on Damascus barrels, &c. 1
———— preserving lime-juice, 119
Bank note engraving, 106
Beets, sugar from 188
Bevel, spur, and band wheels, compared, 7
Black colour, fine 339
Bleaching, Rennie on 171, 205, 312, 338
Blue, Cobalt manufacture of 3
Boat, punt, construction of 52
Boring for water, in New Jersey, 34
Brass, Editor on cleaning and polishing, 284
Brewing, improvement in 108, 245
Browne on Patent Laws, 19, 90, 228, 271, 347
Browning copper medals, &c. 57
Bronzing plaster figures, &c. 154
———— brass goods, 123
Burnishing, 288

PAGE.

Campbell on blast of forges, 59
Carding wool, &c. *patent*, 14
Carriage, safety, *patent*, 36
———— steam, Burtsall & Hill's 250
———— Gurney's 248
———— Long's locomotive 129
Cast-steel, on welding 6, 59
—— iron, on softening 184
———— alloy with type-metal, 374
Canal through Panama, 252
Caterpillars, &c. to clear trees from 56
Cement, Pennsylvania Hydraulic 287
———— Vivat on 371
———— for building, &c. *patent*, 219
Central springs, 34
Chronometers, prize 251
Chubb's detector lock, 193
Cloth, on fulling, *patent*, 90
Cobalt blue, manufacture of 3
Cocoa-nut husk, dying with, *patent*, 15
Copper medals, on browning, 57
Coffins, not to be opened, *patent*, 89
Cooling wort, improved method. 108, 245
Cotton machines, rollers for, *patent*, 306
Collars for horses, *patent*, 345
Colours of dyed stuffs, to prove 55
Cylindrical vessels, to measure 54

Damascus barrels and blades, 1
D'Arcet and Thenard's cement for walls, 246, 276
Description of heater used for do. 376
Detector lock, Chubb's 193
Diaphonous staff, *patent*, 216
Disbrough, his boring for water, 34
Dry rot, to prevent, *patent*, 304
Drawing, important to mechanics, 190
Dyed stuffs, to prove the colour of 55

PAGE.
Dying by cocoa-nut husks, *patent*, 15
—— and printing woolens, &c. *patent*, 218

Earthen-pipes for water, *patent*, 12
Editor on japanning and varnishing, 31, 100, 150, 236, 283
———— bronzing plaster figures, 154
———— polishing wood, &c. 234
———— cleaning and polishing brass, 284
———— slide-rest, 368
———— specific gravity, 353
Einsle on ivory paper, 50
English patents, list of 64, 127, 191, 255, 318
Engraving bank notes, 106
———— Partington on 8, 65, 162, 201, 310, 336
Etching and cleaning, Alabaster 58
———— ground, Turrell on 83
Etruscan vases, 111, 220, 315, 333
Explosions in boilers, Hare on 147
Explosive engine, 115

Feathers, to purify 56
Fender for steam-boats, *patent*, 44
Fire ladder, *patent*, 145
Fire places, Arnot on 226
Flax, hemp, &c. spinning, *patent*, 86
Franklin Institute.
Report on safety carriage, 36
———— on fire ladder, 145
———— on auger for square holes, 240
———— on Renwick's inclined plane, 257, 321
———— on 3d annual exhibition, 264
———— eleventh quarterly 269
———— on anthracite, 296
Quarterly meeting of, 268

Genet on upward force of fluids, 41
Geological survey, proposed, 296
Gill on alloy of cast-iron, &c. 374
—— on browning copper medals, 57
Gilford on hydraulic cement, 287
Gilding, silvering, and tinning, 60
Glass-blowing and cutting, 242
Gold, mineral history of 168, 196
—— Vermont 189
Godman's history of Grizzly Bear, 178
———————— Barking Wolf, 243
———————— Opossum, 358
Gravimeter, Hare on 356
Grist-mill, economical 29
Gun-barrels, &c. Damascus 1

PAGE.
Gurney's steam-carriage, 248

Hausmann on ancient vases, 111, 220, 315, 333
Hare on explosions in boilers, 147
———— atmospheric pressure, 148
———— extinguishing fires in steam-boats, 186
———— hydrometers, 354
———— Nicholson's gravimeter, 356
———— the buoyancy of air, 357
Hats from raw silk, *patent*, 307
Heaters for walls and ceilings, 376
High-pressure engine, 39
Horse-mill, economical 29
Hydraulic cement, Pennsylvania 287
Hydrometer, Hare on 354

Inclined plane, Renwick's 257, 321
———————— letter respecting 329
Iron, manufacture from blooms, 74
—— cast, on softening 184
———— alloy with type-metal, 374
Ivory paper for artists, 50
Japanning and varnishing, Editor on 31, 100, 150, 236, 283

Knight on early crops of peas, 166

Lac varnishes, 102
Lacker for brass, tin, &c. 237
Lackering, 238
Leather, substitute for, *patent*, 243
Lever press, Tyler's improved 105
Lime-juice, preserving 119
Linens, new mode of washing 5
Locomotive carriage, &c. Long's, *patent*, 129

Manufactories in New Hampshire, 204
———————— Massachusetts, 365
Mason and Baldwin's slide-rest, 369
Masts and bowsprits, *patent*, 87
Malt and hops, composition of, *patent*, 306
Mechanical Jurisprudence, 19, 90, 228, 271, 347
Metals, cohesive strength of 120
———— alloy of, *patent*, 215
Mexico, education in 146
Melting pots, Anstey's 159
Mill, economical 29
—— spindle, improved 370
Moore on etching, &c. Alabaster 58
Morey's explosive engine, 115
Mosaic gold, *patent*, 218

PAGE.

New Hampshire, manufactories in 204
Nicholson's operative mechanic, 126
——— gravimeter, Hare on 356

Oil, effect of straining 58
— for watchmakers, 55
Opossum, natural history of 358

Paper, ivory, for artists, 50
——— improvement in making 241
Partington on engraving, 8, 65, 162, 201, 310, 336
Parry and Franklin's expedition, 363
Patents, list of 63, 64, 127, 128, 191, 253, 255, 318, 319
Patent laws, Browne on 19, 90, 228, 271, 347
Peas, raising early crops of 166
Pearl-shell ornaments, *patent*, 17
Perkins' steam engine, 39
Piano forte, improved, *patent*, 18
——— self-acting 188
Pipes for water, *patent*, 12
Plait, Tuscany straw 110
Potatoes, rice from, *patent*, 88
Polishing wood, &c. 234
——— brass, 284
Porcelain manufacture, 242
Pole, North, expedition to 363
Prairie wolf, natural history of 243
Press, lever, improved, 104
Printing and dying stuffs, *patent*, 218
Propelling vessels on canals, *patent*, 14
Protection of ships in storms, 253

Quicksilver vapour engine, 39

Renwick's inclined plane, 257, 321
—— —— letter respecting 329
Refrigerator, economical 125
Rennie on bleaching, 171, 205, 312, 338
Rice, imitation of, *patent*, 88
Roman glass, 247
Rotatory steam engines, 279
Rollers for cotton machines, *patent*, 306

Saddles, improved, *patent*, 217
Salt manufacture, *patent*, 12
Scale and protractor, new 318
Seasoning timber, 69
——— *patent* for 157
Self-acting piano forte, 188
Scibe on welding cast-steel, 6
Shellac varnish, 102
Sheet-iron, to weld 6

PAGE.

Ships protected in storms, 253
Silk-worm, Sharpless on 22, 94, 139
Silk and cotton, Alsop on 81
Slide-rest, Mason and Tyler's 104
——— Mason and Baldwin's 369
——— Editor on 368
Smith's forges, on blast of 59
Specific gravity, Editor on 353
Spinning flax, hemp, &c. *patent*, 86
Spur and other wheels, 7
Spinning cotton, wool, &c. *patent*, 341
Steam engine, high pressure 39
——— rotatory 279
——— remarks on 249
——— on explosions in 147
——— new 186
——— Perkins', notice of 39
Steam vessels, improved 125
——— antiquity of 308
—— carriage, Burtsall and Hill's 250
——— Gurney's 248
—— boats, extinguishing fires in 186
—— power in Great Britain, 366
Straw, Tuscany, for plait, 110
——— plait, *patent*, 303
Steel manufacture, *patent*, 346
—— cast, to weld 6, 59
—— minimum, adhesion of 56
Strickland on softening cast-iron, 184
Sugar from beets, 188
Substitute for leather, *patent*, 343
Sword blades, Damascus 1

Timber, Tredgold on 45, 69, 174, 210
——— seasoning of, *patent*, 157
Trees, to clear, from caterpillars, &c. 56
Turrell on etching ground, 83
Tyler's improved lever-press, 104
Type-founding, improved 241

Upward force of fluids, Genet on, notice of 41

Varnishing and japanning, 31, 100, 150, 236, 283
Vases, ancient 111, 220, 315, 333
Vessels, mode of propelling, *patent*, 14
——— cylindrical, to measure 54
Vicat on cements, 371
Vitruvian cement, *patent*, 219

Waddell, on a punt boat, 52
Washing, new mode of 5
Watchmaker's oil, 55

PAGE.
Water, to prevent freezing of, *patent*, 156
——— boring for 34
Walls preserved from humidity, 246, 276
Welding cast-steel and iron, 6, 59
Williams' safety carriage, 36
Wood, strength of 121
——— seasoning 69, 157
Wool and cotton carding, *patent*, 14
Wort, cooling of 108, 245
Wolf, Prairie, natural history of 243

END OF VOL. II.